

STRUCTURE OF THIS MICROCARD (BASIC INSTRUCTIONS)

A02 = How to use this microcard	1	2	3	4
A01 = Structure of microcard			SIS	
B01 = Trouble-shooting chart	A-***X*	X*XXX	XXXXX	XXXXX *XXXX X
	B-XXXX	XXXXX	XXXXX	XXXXX XXX
	C-XXXXX	XXXXX	XXXXX	XXXXX XXX
	D-XXXXX	XXXXX	XXXXX	XXXXX XXX
	E-XXXXX	XXXXX	XXXXX	XXXXX XX
	F-XXXXX	XXXXX	XXXXX	XXX
	G-XXXXX	XXXXX	XXXX	
	H-			
	J-			
	K-			
	L-			
	M-			
N01 = Service information	N-XXXX	XXXXX	XXXXX	XXX *X XX*
	12345	67890	12345	67890 12345 678
		1	2	
			Index	

N28 = Table of contents and publication information

- 1 = Special features
2 = Safety and precautionary measures
3 = Testers and tools
4 = Installation position of components

- a. Read from left to right.
b. Title of micropicture (appears on each micropicture).

E16	Product/component/test step	
	Coordinate	

c. Limits of section

<u>==></u>	<u><==</u>	<u><==</u>	<u>=> <=</u>
Beginning	Mid-section	End	One-page section
A01			=> <=

HOW TO USE THE MICROCARD

Trouble-shooting instructions for system:

Electronically controlled diesel fuel injection

Descriptions, photos, terminal designations and special features refer to the vehicle:

BMW 324 td
2.4l/6-cyl. engine EU 09.87->

These basic instructions are detailed trouble-shooting instructions. They must not be used as vehicle-specific instructions.
Attention! Descriptions and photos may be different from those in the vehicle-specific brief instructions.

Binding set values, terminal assignments and special features should be taken only from the vehicle-specific brief instructions.
For brief instructions, see the table of contents microcard KFZ-000.

A02		=> <=
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SPECIAL FEATURES

The electronically controlled diesel fuel injection (EDC = Electronic Diesel Control) consists of a distributor-type fuel-injection pump with built-in solenoid-operated controlling unit for regulating fuel delivery instead of a mechanical governor and a solenoid valve for regulating the start of injection.

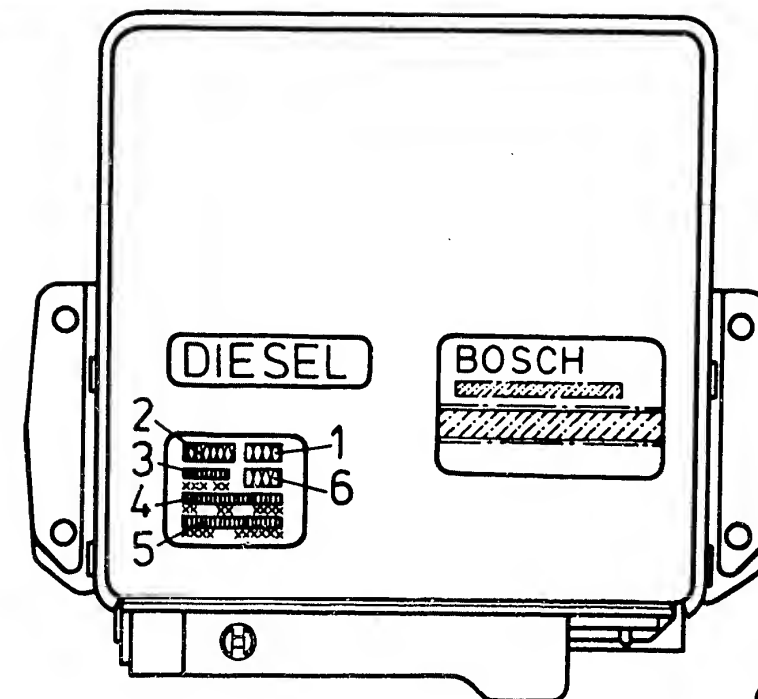
The distributor-type fuel-injection pump is actuated by two control units featuring microprocessor technology. These control units process information from peripheral sensors on:

- * Air, water and fuel temperature
- * Engine speed
- * Start of injection
- * Ambient pressure/boost pressure
- * Driving speed

For monitoring purposes, the EDC system is fitted with self-diagnosis as well as a safety and limp-home program.

Depending on the fault, this program triggers immediate shutoff of the engine or it makes for continued – however restricted – operation of the vehicle.

Faulty EDC-specific components are determined by way of a specially assigned fault/flashing code in each case.

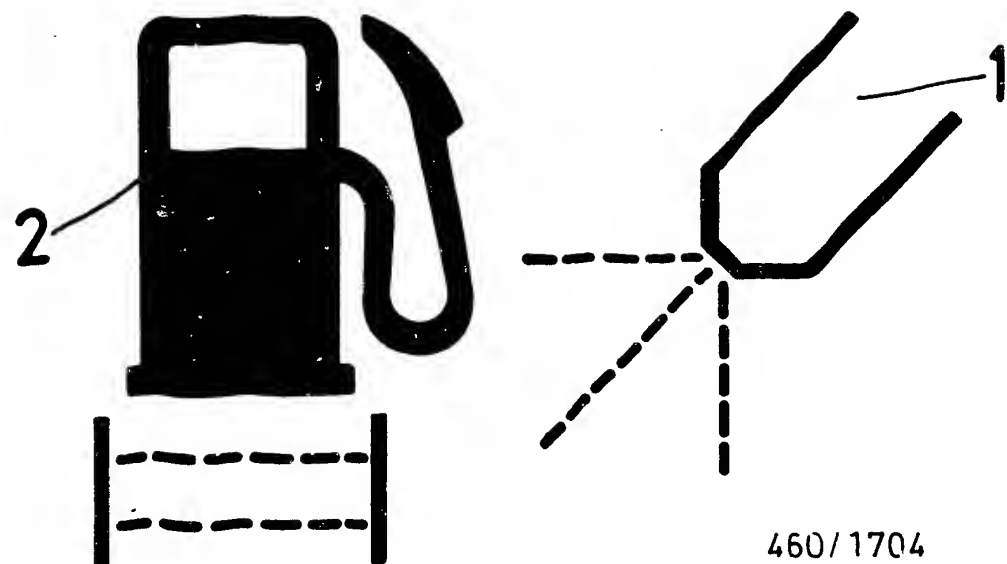


460/2007

- 1 = Variant no.
- 2 = Customer no. (hardware no.)
- 3 = Date of manufacture with calendar day
- 4 = Modification status
- 5 = Consecutive no.
- 6 = Factory code number

SPECIAL FEATURES (continued)

The encoding plate indicates the control-unit versions; the variant no. provides information as to the software status.



460/1704

1 = Display, self-diagnosis
2 = Display, water-level sensor

The instrument panel features a diagnosis lamp (display is combined with water-level-sensor display) which lights up for approximately 5 seconds after switching on the ignition (lamp test).

When the engine is running, a serious fault can be indicated by way of the lamp being permanently lit.

The diagnosis lamp is also used for the flashing-code output of current faults.

SAFETY AND PRECAUTIONARY MEASURES

These measures must be observed in order to prevent damage to engine, control units and peripheral components of EDC.

1. Detach lead at ELAB for testing compression.
2. Never start engine without properly connected battery.
3. Do not use fast charger to start engine. Provide starting aid only with second 12 V battery and starting-aid cable.
4. Disconnect battery from vehicle electrical system before carrying out boost charging.
5. Never disconnect battery from vehicle electrical system with engine running.
6. Never disconnect or attach control-unit plug with ignition switched on.
7. Remove control units in the event of temperatures in excess of + 90° C (drying oven).
8. Remove control units when welding (electrical spot welding).
9. Maximum possible cleanliness is to be observed when working on the quantity actuator. Avoid contact with and do not clean potentiometer track and wiper of control-collar travel sensor. The use of cleaning agents is prohibited.
10. If there is any foreign matter in the quantity actuator, this must always be removed; if necessary, the quantity actuator is to be renewed. Should foreign matter remain in the quantity actuator during operation, this can result in serious impairment of function.

Safety and limp-home program

Fault / limp-home measure

1. Quantity actuator defective:
Engine is shut off via ELAB
2. Timing device defective:
Exhaust gas recirculation is deactivated,
amount of fuel injected is limited.
- 3a. Throttle sensor defective:
Engine runs at constant speed
Manual transmission: 1200 min⁻¹
Automatic: 1450 min⁻¹
- 3b. Comparison, position of throttle sensor
with brake switch, not O.K.:
see under 3a.
- 4a. Speed sensor defective:
Determination of substitute speed from
start-of-injection signal.
Idle speed is increased.
Exhaust gas recirculation is deactivated.
Quantity of fuel injected is reduced.
- 4b. Speed monitoring (overspeed)
Disconnection via quantity actuator (can
be repeated).
5. Needle movement sensor defective:
Amount of fuel injected is limited and
start of injection controlled; exhaust gas
recirculation is deactivated.
6. Vehicle speed sensor defective:
No idle increase when driving (manual
transmission).
- 7a. Operating unit of cruise control defective:
Cruise control is deactivated.
- 7b. Comparison with brake and coupling switch not
O.K.:
see under 7a.

Safety and limp-home program (continued)

8. Additional overrun monitoring:
Comparison of position of throttle sensor or
cruise control (with brake switch)
with control-collar travel sensor not O.K.:
Disconnection via quantity actuator (can be
repeated).
9. Transmission actuator (automatic transmission)
defective:
Disconnection of cruise control.
10. Engine temperature sensor defective:
Control unit uses substitute values.
The exhaust gas recirculation is deactivated.
Control of start of injection.
11. Air temperature sensor defective:
Control unit uses substitute values and
exhaust gas recirculation is deactivated.
12. Fuel temperature sensor defective:
Control unit uses substitute values.
- 13a. Control-collar travel sensor defective:
Engine is switched off via ELAB.
- 13b. Comparison of position of control-collar
travel sensor with needle-movement-sensor
pulse in overrun not O.K.:
Injected-quantity disconnection via quantity
actuator in overrun.
14. Boost pressure sensor/atmospheric pressure
sensor defective:
Quantity of fuel injected is limited, control
unit uses substitute values.
15. Computer-communication interface defective:
Quantity of fuel injected is reduced.
Control units use substitute values.

Safety and limp-home program
(continued)

16. Control unit (computer monitoring) defective:

Control unit 1 defective:
Quantity actuator is disconnected.

Control unit 2 defective:
Solenoid valve for start of injection
deenergized,
exhaust gas recirculation is deactivated,
quantity of fuel injected is limited.

17. Pressure charging regulator defective:
Quantity of fuel injected is limited,
boost pressure control.

18. Speed-signal interface defective:
Quantity of fuel injected is limited,
start of injection controlled.

19. Comparison of position of brake/brake safety
switch not O.K.:
Cruise control is disconnected.

INSTALLATION POSITION OF COMPONENTS

* Control unit for lambda closed-loop
control:
On right beneath rear seat.

* Timing valve:
In engine compartment where drive shaft
passes through body.

* Lambda sensor:
In engine compartment in exhaust manifold.

* Lambda measurement output:
In engine compartment, 2-pin plug
connection on left wheel well.

* Fuel-pump relay:
In engine compartment in central electrics
box on left wheel well.

* Time-lag relay, warm-start relay:
In engine compartment at central lambda
relay position on left wheel well.

* +25°C temperature switch:
In engine compartment in intake manifold.

* +45°C temperature switch, thermo-time switch, warm-up
regulator, auxiliary-air device: In engine
compartment, in thermostat housing at front of engine.

* Start valve:
In engine compartment on throttle-valve
assembly.

* Pressure-surge switch:
In engine compartment on left wheel well
beside fuel filter.

* Solenoid-op. valve for overrun cut-off:
In engine compartment above air filter in
rubber elbow.

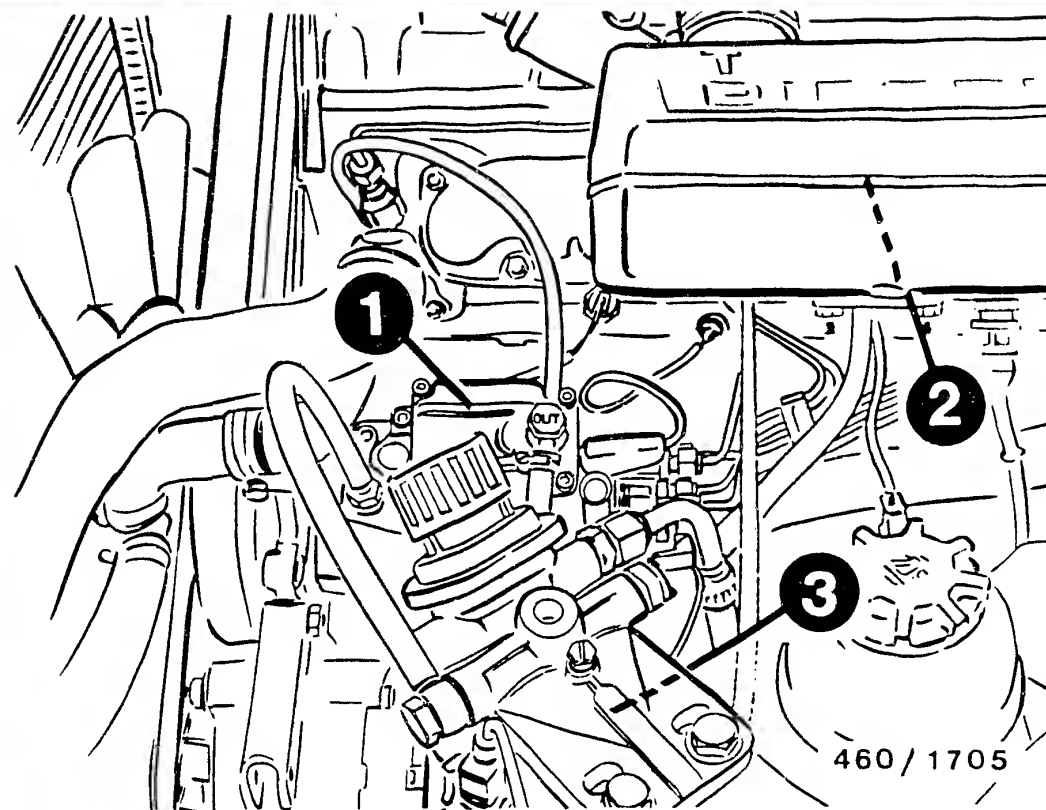
* Electric fuel pump, pre-supply pump:
In fuel tank beneath trunk floor.

TESTERS AND TOOLS (continued)

Designation	Part no.	Application
Nozzle tester	EFEP 60 H 0 681 200 502	Testing injection nozzles
Compression tester with connecting nipple	Commercially available Measuring range: 0 - 30 bar	Testing engine compression
Compression-loss tester	EFAW 210 A 0 681 001 901	Testing loss of engine compression
Rev counter	ETD 019.02 0 684 101 902	Testing engine speed
Differential pressure gauge	Commercially available Measuring range: -1.0 to 4.0 bar Class 1.0	Filter test
Evaluation unit Accessories box with metering unit	0 684 102 050 0 681 169 038 or 0 681 169 058	Smoke test
Pressure piece	KDEP 1043/0/5	Disassembling and assembling fuel injector
Test adapter	KDEP 1165	Testing EDC system
Adapter leads	KDEP 1165/300 - /301	Testing EDC system
Test lead	KDZS 0004	Testing EDC system
Test lead	KDUM 0008	Testing EDC system
Test lead	KDUM 0007	Testing EDC system
Test lead	Commercially available Pin dia. 4 mm	Testing EDC system
Multimeter	Bosch MMD 301 0 684 500 301	Testing EDC system

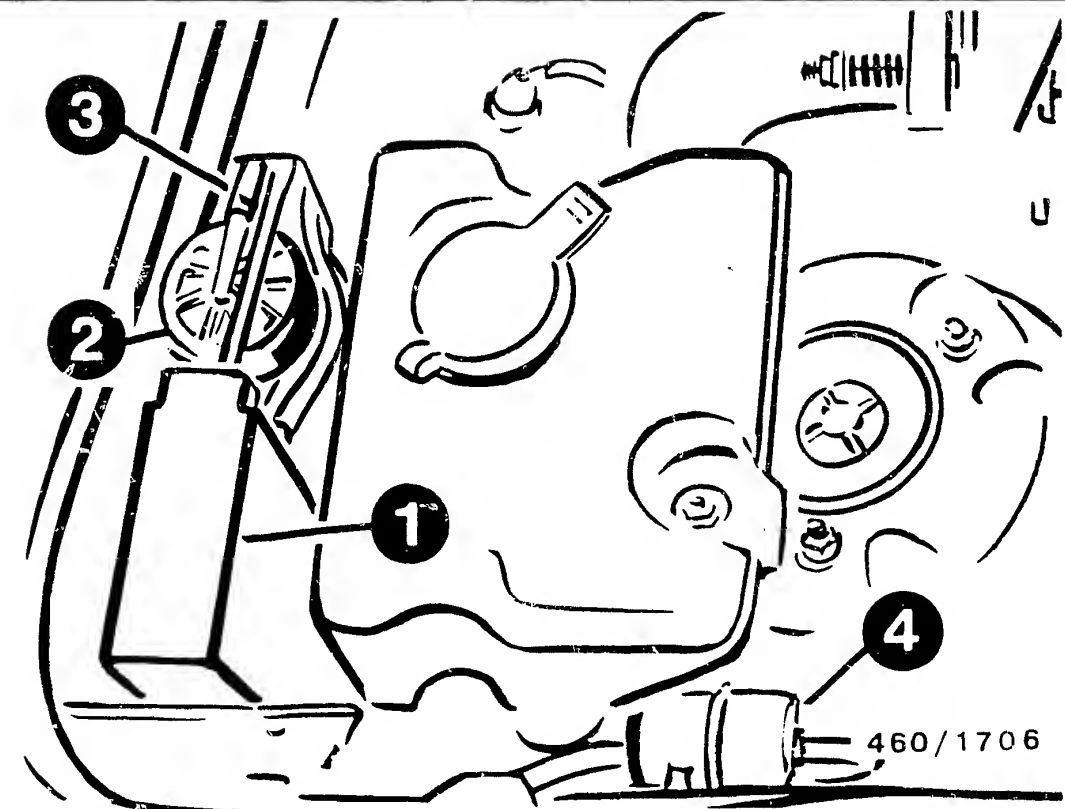
TESTERS AND TOOLS (continued)

Designation	Part no.	Application
Multimeter (analog)	Commercially available	Testing EDC system
Engine tester MOT 201 300 400	0 684 000 201 0 684 000 300 0 684 000 400	Testing EDC system
Test prod (red)	1 684 485 035	Testing EDC system
Test prod (black)	1 684 485 034	Testing EDC system
Evaluation unit for flashing-code diagnosis	KDAW 9980	Stimulating self-diagnosis
VA tester	ETT 011.00 0 684 101 100	Testing glow plug system
Press-in sleeve	KDEP 1562	Assembling nozzle-holder gasket
Pressure/vacuum tester	ETT 007.01	Testing vacuum pump
Cover	KDEP 1180	Renewing fuel temperature sensor

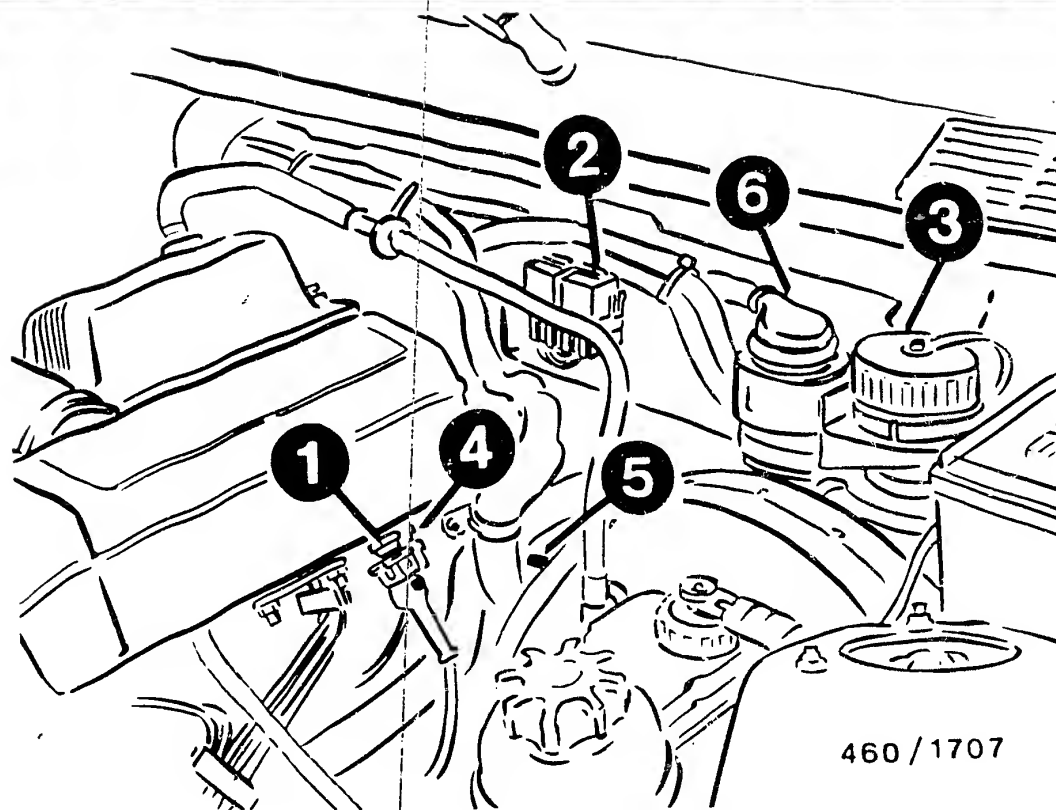


INSTALLATION POSITION OF COMPONENTS

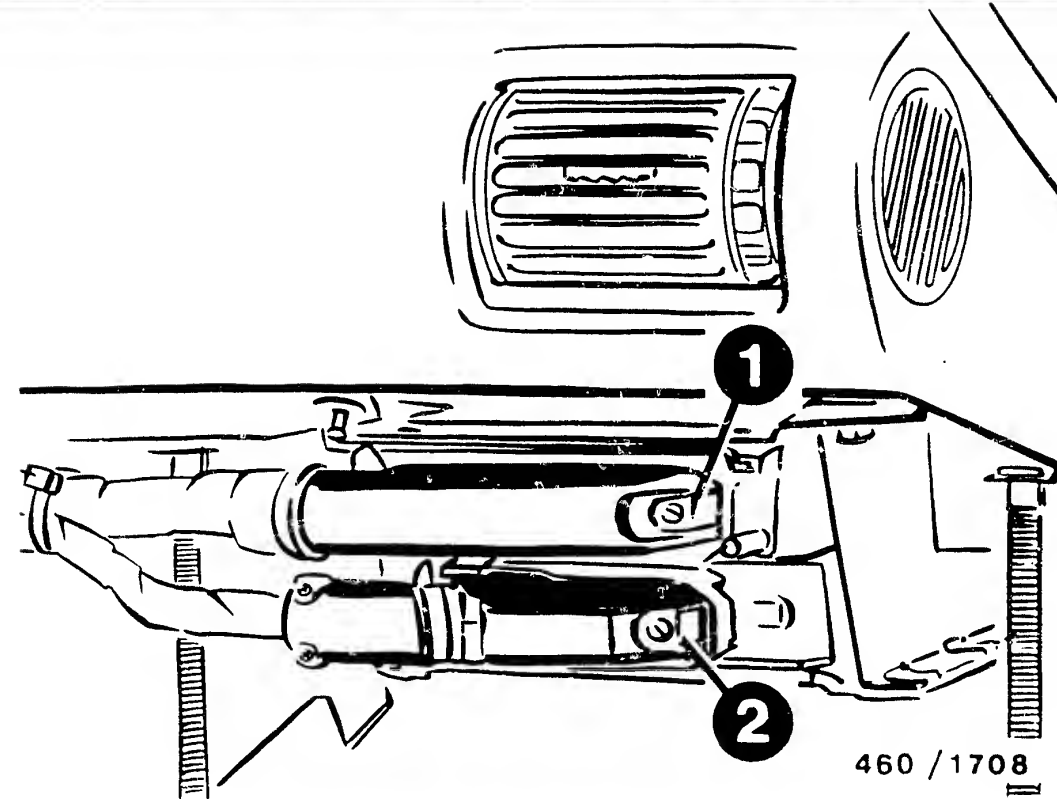
- 1 = Injection pump
- 2 = Nozzle-holder assembly with needle-movement sensor (cylinder 4)
- 3 = Charge-air pressure sensor (mounted beneath the fuel-filter mounting)



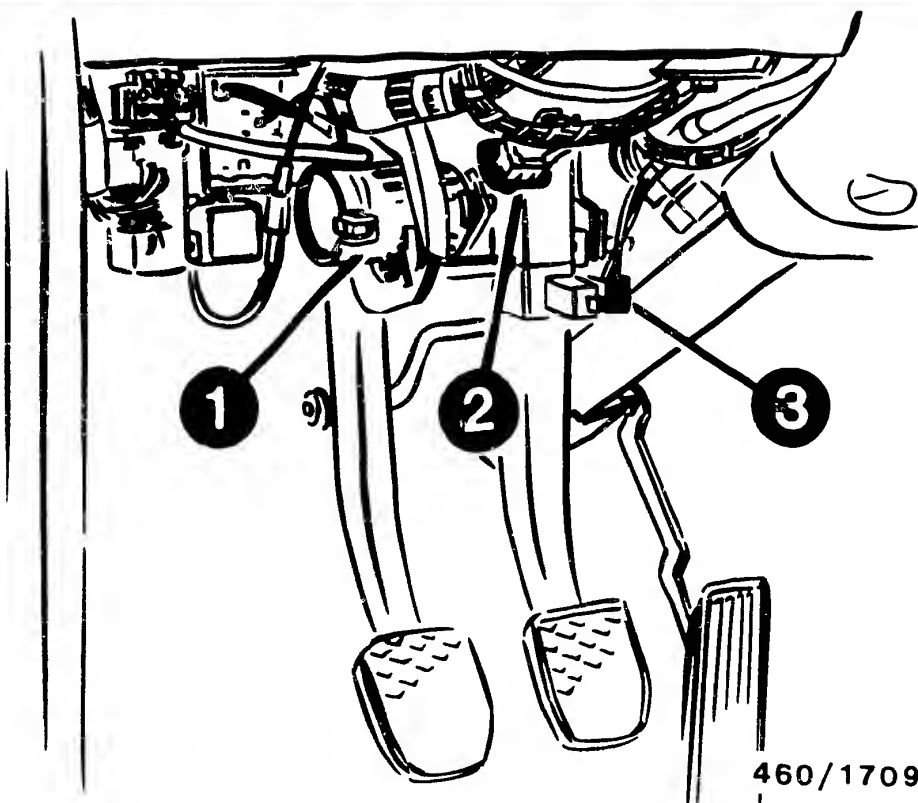
- 1 = Glow-duration control unit
- 2 = Electropneumatic pressure transducer (closed-loop charge-air-pressure control)
- 3 = Electropneumatic switch-over valve (exhaust-gas recirculation, mounted behind cover)
- 4 = Air filter



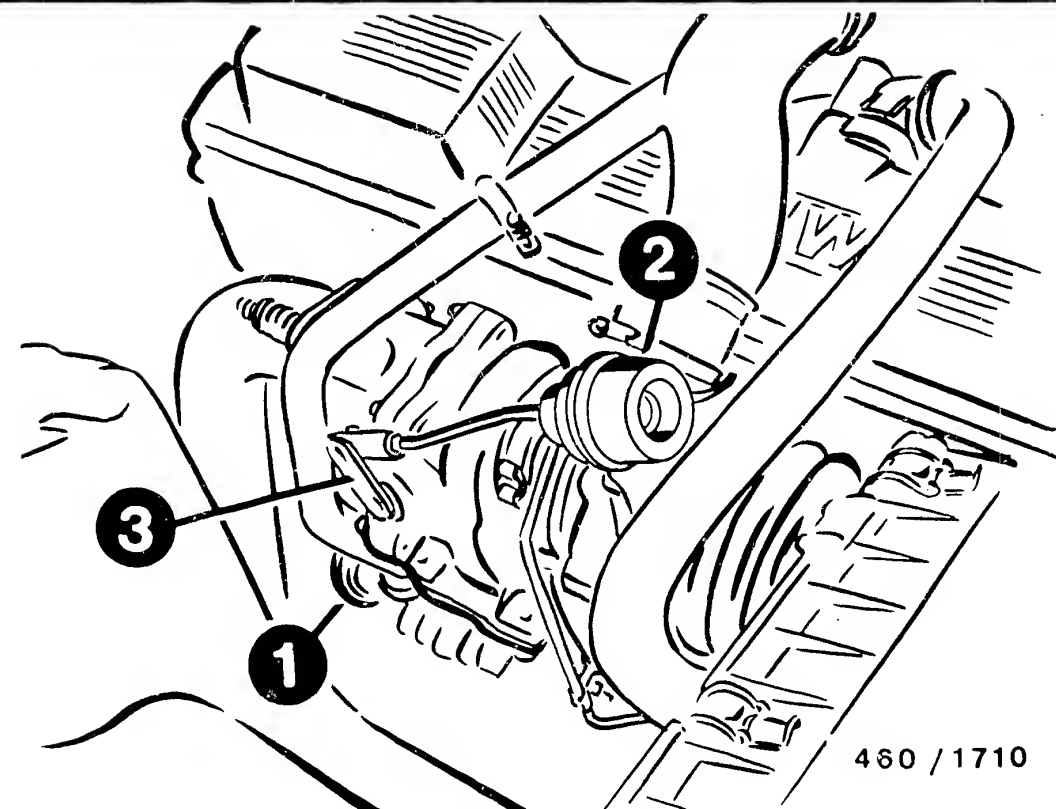
- 1 = Air temperature sensor
- 2 = Reversed-polarity protection relay
- 3 = 20-pole diagnosis plug
- 4 = Engine temperature sensor
(attached to cylinder head)
- 5 = Speed sensor
(attached to engine block)
- 6 = Engine plug



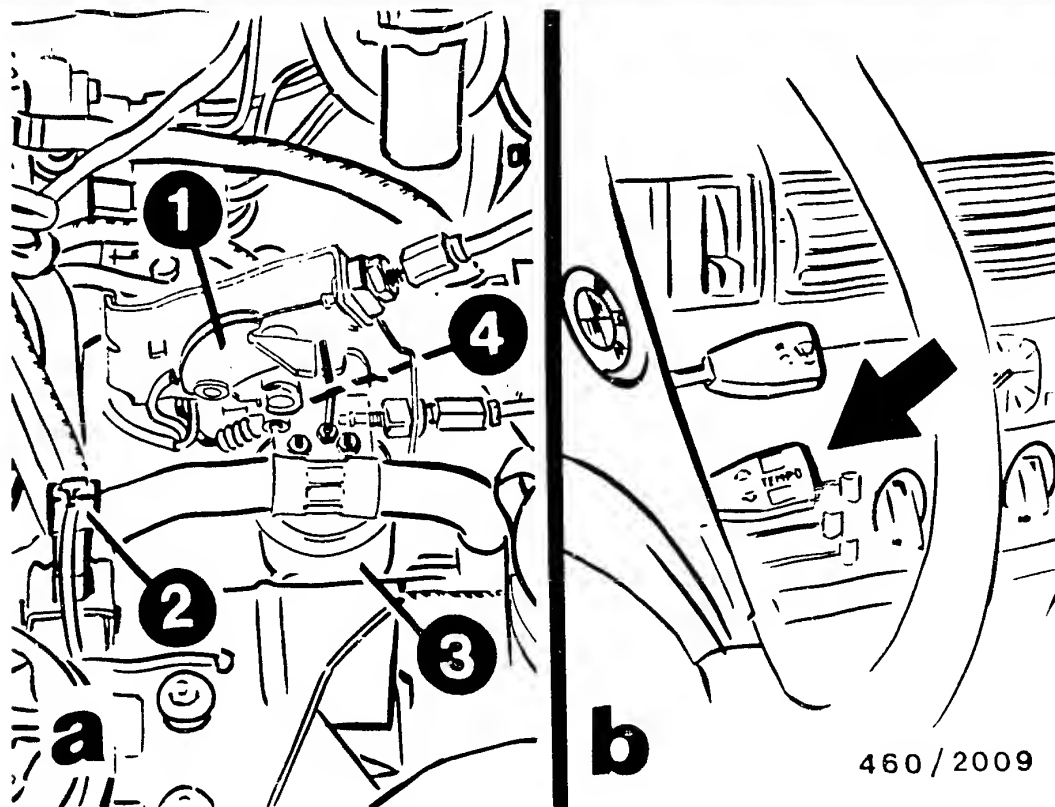
- 1 = Delivery and road-speed control unit
(designated Control unit 1 in these instructions)
- 2 = Start-of-injection and exhaust-gas-recirculation control unit (designated Control unit 2 in these instructions)



- 1 = Pedal-operated sensor
 - 2 = Coupling switch
 - 3 = Brake/brake safety switch
- The vehicle speed sensor is attached to the cover of the differential.



- 1 = Exhaust-gas recirculation valve
- 2 = Control box (LDR)
- 3 = Bypass-flap actuator

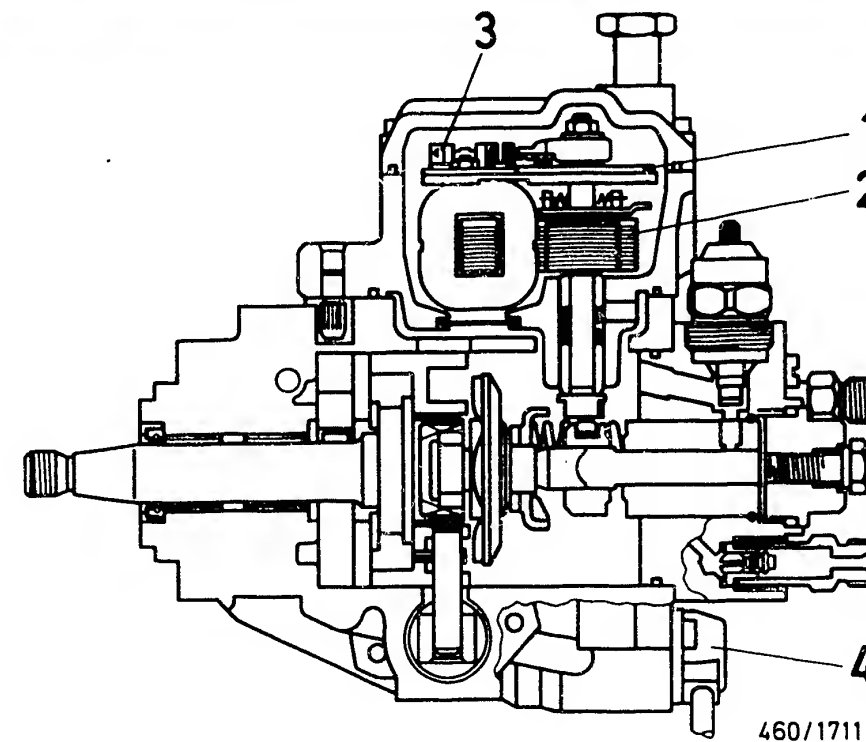


Vehicles with automatic transmission (picture a)

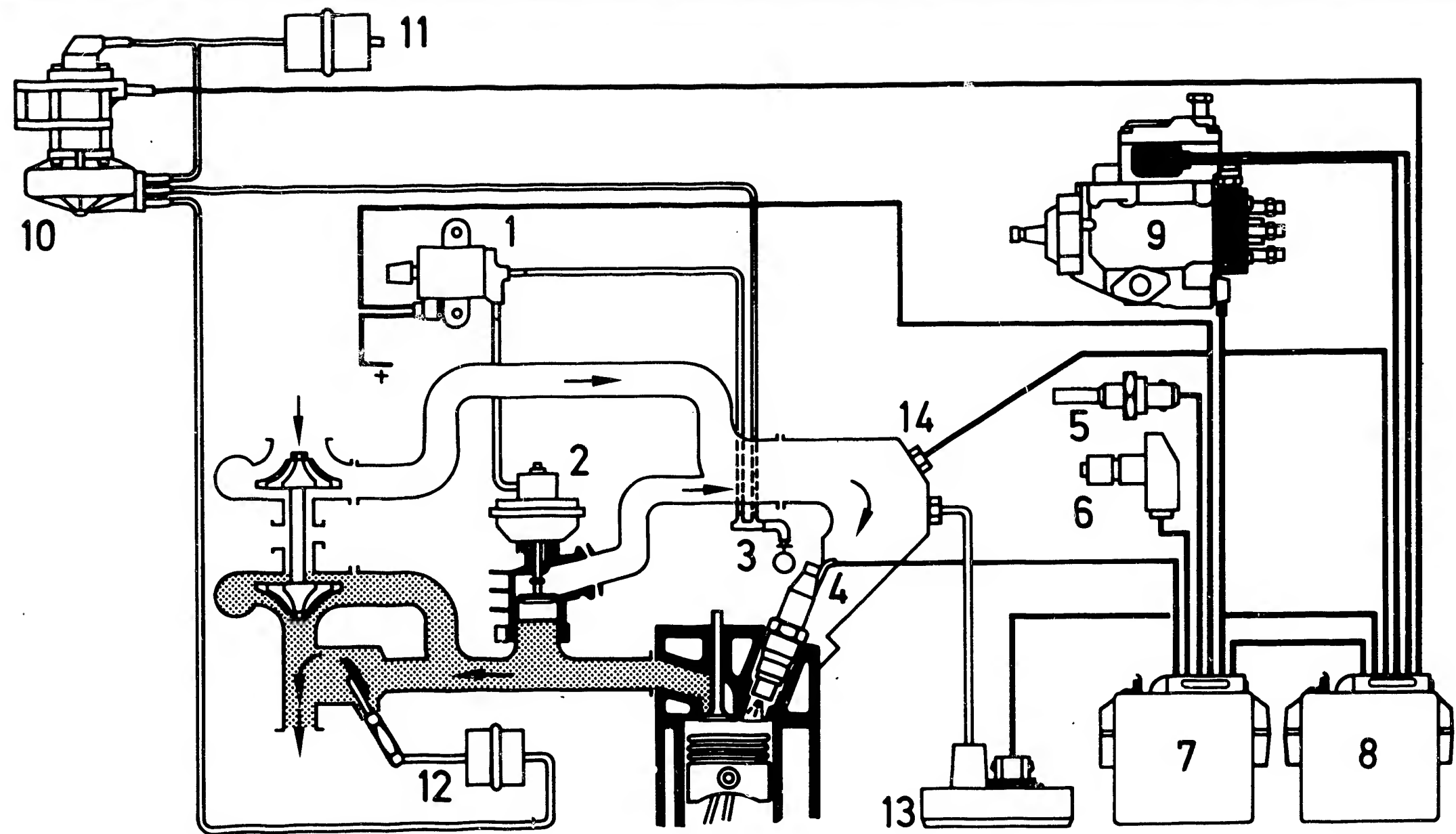
- 1 = Automatic transmission control
- 2 = Electropneumatic switching valve (FGR)
- 3 = Control unit (FGR)
- 4 = Transmission indicator (not visible in picture)

The electropneumatic switching valve is installed in the transmission, whereas the transmission neutral switch is installed in the gear-shift console.

Cruise-control operating unit (picture b, arrow).



- 1 = Control-collar travel sensor
- 2 = Quantity actuator
- 3 = Fuel temperature sensor
- 4 = Start-of-injection solenoid valve

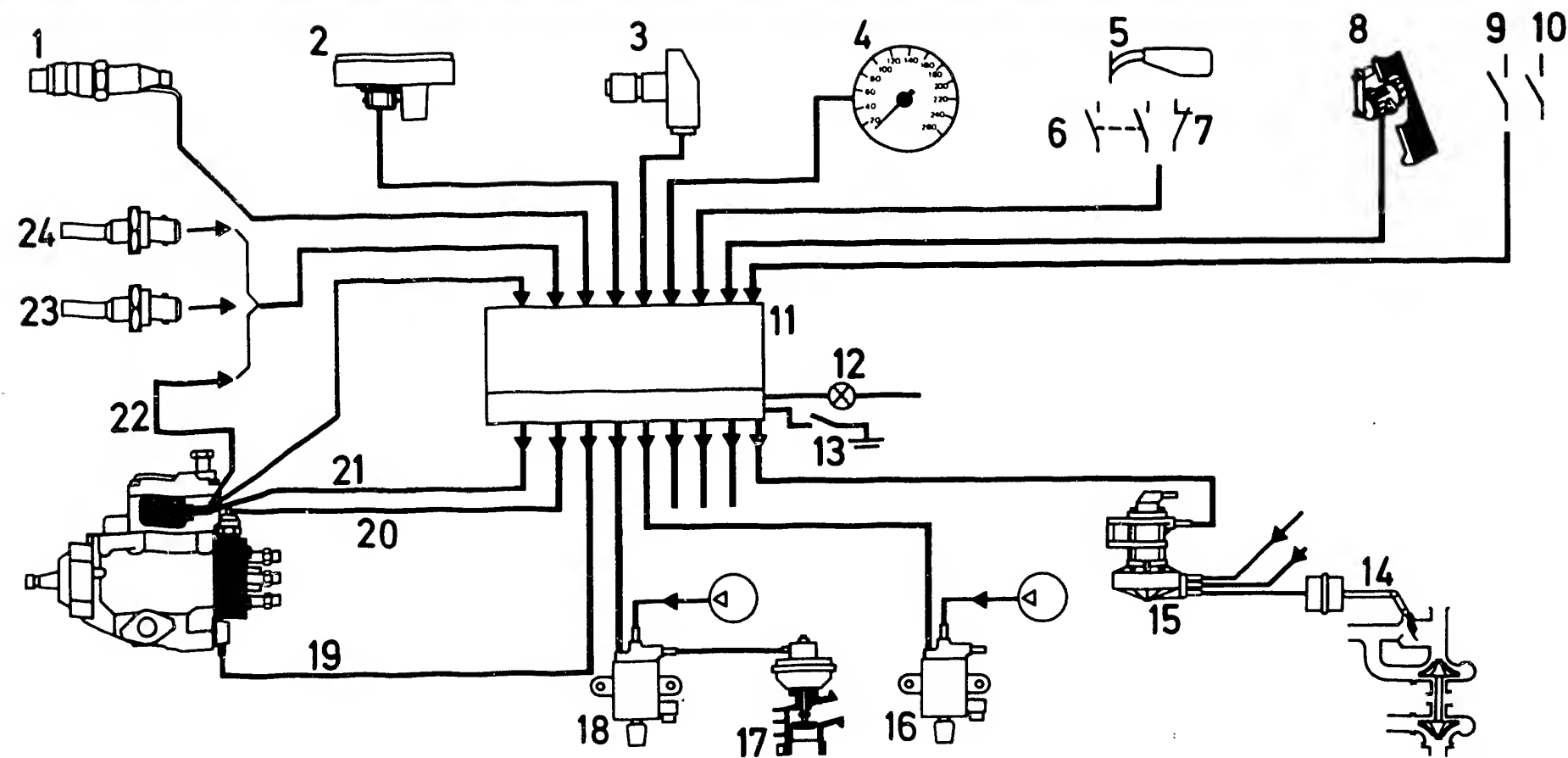


460/1712

BLOCK DIAGRAM OF EXHAUST GAS RECIRCULATION AND PRESSURE CHARGING REGULATOR

- 1 = Electropneumatic switching valve (EGR)
- 2 = EGR valve
- 3 = Vacuum pump
- 4 = Needle movement sensor
- 5 = Engine temperature sensor
- 6 = Speed sensor
- 7 = Control unit 2

- 8 = Control unit 1
- 9 = Fuel-injection pump
- 10 = Electropneumatic vacuum converter (LDR)
- 11 = Air filter and atmospheric venting
- 12 = Bypass-flap actuator
- 13 = Boost pressure sensor
- 14 = Air temperature sensor



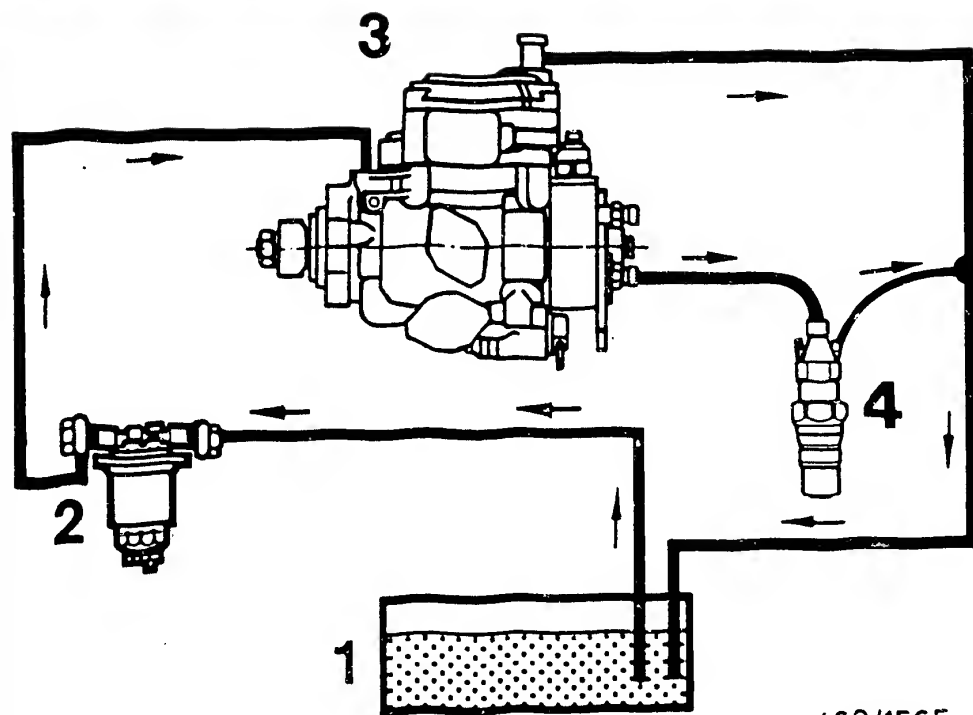
460/2010

SYSTEM OVERVIEW - EDC - BMW 324 Turbo Diesel (9.87->)

- 1 = Nozzle holder with needle movement sensor
- 2 = Boost pressure sensor
- 3 = Speed sensor
- 4 = Speed signal sensor
- 5 = Cruise-control operating unit
- 6 = Brake/brake safety switch
- 7* = Coupling switch
- 8 = Throttle sensor with safety switch
- 9 = Transmission indicator
- 10 = A/C switch
- 11 = Control units
- 12 = Diagnosis lamp

- 13 = Diagnosis stimulation
- 14 = Bypass-flap actuator
- 15 = Electropneumatic vacuum converter
- 16 = Electropneumatic switching valve (FGR)
- 17 = EGR valve
- 18 = Electropneumatic switching valve (EGR)
- 19 = Start-of-injection solenoid valve
- 20 = ELAB
- 21 = Quantity actuator
- 22 = Fuel temperature sensor
- 23 = Engine temperature sensor
- 24 = Air temperature sensor

(* Vehicles with automatic transmission, transmission neutral switch)



460/1565

- 1 = Fuel tank
- 2 = Fuel filter with water level sensor
- 3 = Distributor-type fuel-injection pump
- 4 = Injection nozzles

For production reasons:
continued on the following
coordinate.

DIAGRAM OF FUEL LINES

The fuel lines are connected in accordance with the diagram above.

The fuel flows in the direction of the arrow.

HOW TO USE TROUBLE-SHOOTING CHART AND TROUBLE-SHOOTING PROGRAM

The TROUBLE-SHOOTING CHART starts with Coordinate B06 and contains customer complaint (fault symptom/fault characteristic feature) together with several possible causes in each case (component faults) and coordinate information for detailed trouble-shooting. If no coordinates are given, this is because the causes concerned do not require any test instructions.

In the event of a clearly established customer complaint, proceed consecutively and step by step as indicated in the trouble-shooting instructions in the stated sequence of possible causes.

Trouble-shooting should always be commenced with self-diagnosis (if provided) or with the universal test adapter (if envisaged). Only then should trouble-shooting be continued in line with the trouble-shooting chart.

In the event of a customer complaint which is not clear-cut, all causes indicated in the trouble-shooting chart must be tested. In order to avoid incorrect measurements, all causes are to be checked in the specified sequence (on account of interlinkage of test steps).

HOW TO USE TROUBLE-SHOOTING CHART AND TROUBLE-SHOOTING PROGRAM (CONTINUED)

The TROUBLE-SHOOTING PROGRAM contains all system and component tests indicated in the trouble-shooting chart. It is sub-divided into three rows of boxes.

The left-hand column contains test instructions and set values.

The center column contains information on trouble-shooting and fault elimination.

The right-hand column contains pictures/connection diagrams linked to the text together with explanatory notes.

If the questions posed in the left-hand column can definitely be answered with "yes", trouble-shooting is to be continued with the next box below.

If the answer to the question is "no", the center column must be applied and the tests performed in the sequence indicated there.

Following fault elimination, repeat test as a check.

TEST PREREQUISITES:

- Battery fully charged
- Engine in proper mechanical working order (e.g. compression, valve clearance etc.)
- Engine at operating temperature of approx. +80°C (if necessary)
- Proper connection of all connectors of wiring harness

HOW TO USE SELF-DIAGNOSIS, SELF-DIAGNOSIS TEST TABLE AND SELF-DIAGNOSIS TROUBLE-SHOOTING PROGRAM

The control units of the electronically controlled diesel fuel injection (EDC = Electronic Diesel Control) feature a self-diagnosis system, so as to be able to detect defective components/conductor paths and to monitor control functions.

Trouble-shooting must therefore always be preceded by self-diagnosis.

Switch on ignition. The diagnosis lamp lights up for approximately 5 seconds (lamp test).

Once the lamp has gone out, the self-diagnosis can be called up.

If the diagnosis lamp lights up continuously, then there is a serious fault present.

If the diagnosis lamp does not light up after actuating the key-operated switch, test self-diagnosis facility.

The self-diagnosis features 2 interrogation possibilities:

1. Current faults can be output as a flashing code after stimulating the self-diagnosis.
2. Stored faults can only be called up with the pocket tester KTS 300.

Several faults can be called up consecutively. If the voltage supply for the control units is interrupted, then the stored faults are cleared.

Test instruction:

Always switch off ignition before detaching or connecting control-unit plugs.

HOW TO USE SELF-DIAGNOSIS, SELF-DIAGNOSIS TEST TABLE AND SELF-DIAGNOSIS TROUBLE-SHOOTING PROGRAM (CONTINUED)

As of Coordinate B 11 a description is given of self-diagnosis via fault-memory interrogation with:

- KTS 300 and
- flashing-code evaluation.

The self-diagnosis test table starting as of Coordinate B 16 contains:

- Fault indication (fault code, flashing code)
- Checked components or system functions
- Test instructions/test conditions
- Terminals
- Set values
- Indication of coordinates for trouble-shooting and fault elimination in subsequent self-diagnosis trouble-shooting program

HOW TO USE SELF-DIAGNOSIS, SELF-DIAGNOSIS TEST TABLE AND SELF-DIAGNOSIS TROUBLE-SHOOTING PROGRAM (CONTINUED)

The self-diagnosis trouble-shooting program is split up into 3 columns as of Coordinate B19.

The left-hand column contains test instructions and set values.

The center column contains information on troubleshooting and fault elimination.

The right-hand column contains pictures/terminal diagrams belonging to the text together with explanatory notes.

If the questions posed in the left-hand column can definitely be answered with "yes", trouble-shooting is to be continued with the next box below.

If the answer to the question is "no", the center column must be employed and the tests performed in the sequence indicated there.

If the self-diagnosis indicates a fault, but there is no system or component fault, the control unit is to be replaced.

If no further system-specific faults are indicated by the self-diagnosis and the customer complaint (fault symptom) has still not been eliminated, trouble-shooting must be continued with the trouble-shooting chart as of Coordinate B06.

TROUBLE-SHOOTING CHART

Customer complaint (fault symptoms)

1. Diagnosis lamp
2. Starting motor operates, engine fails to start or starts only with difficulty (warm and cold)
3. Engine hunts when idling
4. Rough idling with warm engine
5. High fuel consumption in conjunction with inadequate engine power and formation of smoke
6. Inadequate performance
7. Black fumes in full-load range in conjunction with rough engine running, possible loss of power
8. Hard engine running

								Cause (component fault)	Coord.
*	*	*	*	*	*	*	*	Self-diagnosis	B11
	*							Control-unit voltage supply	F05
	*							Quantity actuator	E13
	*							Control-collar travel sensor	D25
	*							ELAB	G23
	*			*	*			Computer monitoring (control unit 2)	C13
				*	*			Start-of-injection solenoid valve	E23
					*			Electropneumatic switching valve (EGR)	F25
				*				Nozzle holder with needle-movement sensor (NBF)	E17/ H21
				*				Computer-communication interface	C07
				*	*			Speed sensor	C19
	*							Speed sensor and NBF	C19/ H21
	*		*	*				Tank empty, tank ventilation	G28
	*		*		*			Injection sequence not firing sequence	G27

TROUBLE-SHOOTING CHART (continued)

Customer complaint (fault symptoms)

1. Diagnosis lamp
2. Starting motor operates, engine fails to start or starts only with difficulty (warm and cold)
3. Engine hunts when idling
4. Rough idling with warm engine
5. High fuel consumption in conjunction with inadequate engine power and formation of smoke
6. Inadequate performance
7. Black fumes in full-load range in conjunction with rough engine running, possible loss of power
8. Hard engine running

Cause (component fault)								Coord.
*	*	*	*	*	*	*	*	Self-diagnosis B11
		*						Inlet-union screw, fuel return H09
*		*						Air in fuel system H01
*								Paraffin separation G15 H03
*		*						Leakage in fuel lines H09
*								Supply lines clogged H09
*	*	*	*	*	*	*	*	Injection nozzle H21
*	*	*	*	*	*	*	*	Pump/engine assignment L01
*								Fuel filter H03
*								Glow plug system G05
*	*	*						Engine compression J08
		*	*					Engine air filter H10
*		*	*	*				Engine management K08
			*	*				Timing device E23
			*					Turbocharger E11
			*					Boost pressure sensor D17
			*					Pressure charging regulator E07
*								Fuel heating G15
			*					EGR valve F25

TROUBLE-SHOOTING CHART (continued)

Customer complaint (fault symptoms)

9. Diagnosis lamp
10. Engine cuts out when driving
11. Engine switches off automatically
12. Engine runs at constant speed
13. Engine doesn't rev up when cold
14. High idle/rough engine running at high speed
15. Black fumes in full-load range
16. Cloud of white fumes in full-load range

Cause (component fault)								Coord.
*	*	*	*	*	*	*	*	Self-diagnosis B11
		*						Throttle sensor and brake/brake safety switch D11/ F01
	*							Quantity actuator E13
	*							Control-collar travel sensor D25
	*							Comput. monitoring (cont. unit 1) C11
	*							Speed sensor and NBF C19/ E17
*	*	*	*	*	*	*	*	Tank empty, tank ventilation G27
		*	*	*	*	*	*	Injection sequence not firing sequence G27
*		*						Inlet-union screw, fuel return H09
*		*						Air in fuel system H01
		*						Paraffin separation G15 H03
*								Leak in fuel lines H09
*		*			*	*	*	Supply lines clogged H09

TROUBLE-SHOOTING CHART (continued)

Customer complaint (fault symptoms)

9. Diagnosis lamp
10. Engine cuts out when driving
11. Engine switches off automatically
12. Engine runs at constant speed
13. Engine doesn't rev up when cold
14. High idle/rough engine running at high speed
15. Black fumes in full-load range
16. Cloud of white fumes in full-load range

								Cause (component fault)	Coord.
*	*	*	*	*	*	*	*	Self-diagnosis	B11
				*		*	*	Pump/engine assignment	L01
				*		*	*	Fuel filter	H03
				*			*	Engine compression	J08
			*				*	Safety switch, throttle sensor	D05
	*						*	Fuel heating	G15
	*						*	ELAB	G23
				*			*	Speed sensor	C19

TROUBLE-SHOOTING CHART (continued)

Customer complaint (fault symptoms)

- 17. Diagnosis lamp
- 18. High idle
- 19. FGR operation not possible
- 20. No EGR function
- 21. No idle speed increase

						Cause (component fault)	Coord.
*	*	*	*			Self-diagnosis	B11
			*			Computer monitoring	C11/ C12
			*			Start-of-injection solenoid valve	E23
			*			Electropneumatic switching valve (EGR)	F25
			*			Nozzle holder with needle movement sensor	E17
	*		*			Speed sensor	C19
	*		*			Speed signal sensor	B25
		*				Coupling switch or transmission neutral switch and/or brake/brake safety switch	F01/ F09/ F19
			*			Air temperature sensor	C15
			*			Engine temperature sensor	B19
				*		A/C switch	F11
		*				Cruise-control operating unit	C01
		*				Speed-signal interface	E27
		*				Electropneumatic switching valve (automatic, FGR)	F13

SELF-DIAGNOSIS WITH POCKET TESTER KTS-300 AND VIA FLASHING-CODE EVALUATION

An integrated self-diagnosis system in both control units (output only via control unit 2) makes it possible to localize a faulty component or a faulty conductor path. Minor faults are not indicated, severe faults cause the diagnosis lamp to light up continuously. Detected faults are stored, i.e. even limited-time faults (e.g. loose contact at multiple butt connector) are not cleared after switching off the ignition.

A maximum of 5 faults can be stored in chronological order. Severe faults are always stored even if the fault memory is full. A minor fault is overwritten, the severe fault is classified chronologically. A frequency counter stores the information on the number of times a fault occurs. Sporadic faults (e.g. loose contacts) are always set to the highest count.

Program output starts with the fault stored first.

Current faults can be interrogated by way of the flashing code and pocket system tester KTS 300. Stored faults are interrogated with the pocket system tester KTS-300.

Note :

If the voltage supply to the control unit is interrupted, stored self-diagnosis faults are cleared.

Flashing-code evaluation with throttle sensor

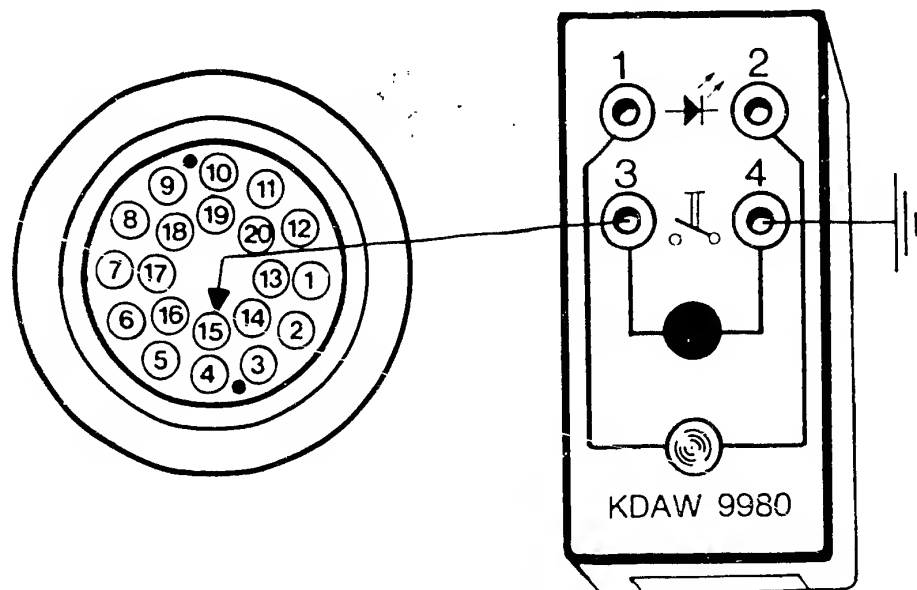
Flashing-code evaluation by means of 5 x actuation of the accelerator pedal over a period of 5 seconds. The accelerator pedal must always be moved from the idle position to the full-throttle position.

Stimulation can only be effected:

- with engine stopped and
- ignition switched on.

1. Wait for lamp test.
2. In order to avoid erroneous triggering, self-diagnosis must be stimulated in the time span indicated above.
3. Flashing code of corresponding component is indicated.
4. Repeat stimulation:
 - a. if there is no further fault present, the same fault is displayed again
 - b. if further faults are present, these are indicated after each renewed stimulation process.

Note: Flashing-code evaluation is not possible if the throttle sensor is defective.



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Flashing-code evaluation using the evaluation unit for flashing-code diagnosis KDAW 9980

Flashing-code evaluation is effected with the evaluation unit for flashing-code diagnosis KDAW 9980.

Stimulation can be carried out:

- with ignition switched on o r
- with engine running.

1. Wait for lamp test.
2. In order to avoid erroneous triggering, the self-diagnosis must be stimulated for at least 4 seconds.
3. The flashing code of the corresponding component is displayed.
4. Repeat stimulation:
 - a. if there is no further fault, the same fault is displayed again
 - b. if further faults are present, these are indicated following each renewed stimulation process.

Clearing fault memory

1. Stored faults can be cancelled following fault elimination (frequency counter set to zero) by switching the ignition on and off once or several times.
2. The fault memory is cleared with the pocket system tester KTS 300.

Testing the self-diagnosis:

After the ignition has been switched on, the diagnostic lamp lights up for approx. 5 seconds.

If this is not the case, conduct the following tests:

1. Test the indicator lamp and replace if necessary.
2. Test the following electric leads for open circuit:
 - * control unit 2, terminal 11 to indicator lamp
 - * indicator lamp to fuse, terminal 15
 - * control unit 2, terminal 18 to diagnostic plug, socket 15
3. Replace control unit 2.

SELF-DIAGNOSIS TABLE

Pocket system tester Fault indication	Fault code	Flash- ing code	Coor- dinate
Engine temp. sensor Op.-circ./sh. to B+	3	1	B19
Short to ground			
Speed-signal sensor incorrect/no signal	9	7	B25
Cruise control operating element op.circ./sh. to B+	10	3	C01
Short to ground			
Computer comm. interface defective	11	5	C07
Air-temp. sensor Op.circ./sh. to B+	12	6	C15
Short to ground			
Engine-speed sensor Op.circ/sh. to grnd.	129	14*	C19
Signal error			
Fuel temperature sensor Op.-circ./sh. to B+	130	4	C25
Short to ground			

* Serious fault, diagnosis lamp permanently lit

SELF-DIAGNOSIS TABLE (continued)

Pocket system tester Fault indication	Fault code	Flash- ing code	Coor- dinate
Pedal-position sensor potentiometer Signal too high Signal too low Comparison not O.K.	132	2	D05
Charge-pressure sensor Signal too high Signal too low	133	8	D17
Wiper-travel sensor Signal too high Signal too low Comparison not O.K.	134	12	D25
Supercharger control circuit defective	135	9	E07
Flow actuator control circuit defective	136	10*	E13
Needle sensor Signal too high Signal too low	142	11*	E17

* Serious fault, diagnosis lamp permanently lit

SELF-DIAGNOSIS TABLE (continued)

Pocket system tester Fault indication	Fault code	Flash- ing code	Coor- dinate
Injection initiation control defective	144	15	E23
Engine-speed signal interface defective	145	—	E27
Brake/brake- signal switch Comparison not O.K.	146	—	F01

SELF-DIAGNOSIS TEST PROGRAM (1)

V

Temperature sensor
Engine
Open-circuit/short-circuit
to positive
Fault code: 3
(Flashing code: 1)

N>

Renew engine temperature sensor.

Detach plug
(Picture, top. Temperature sensor
not visible in picture).

Connect multimeter with test leads
KDUM 0008 to temperature sensor.

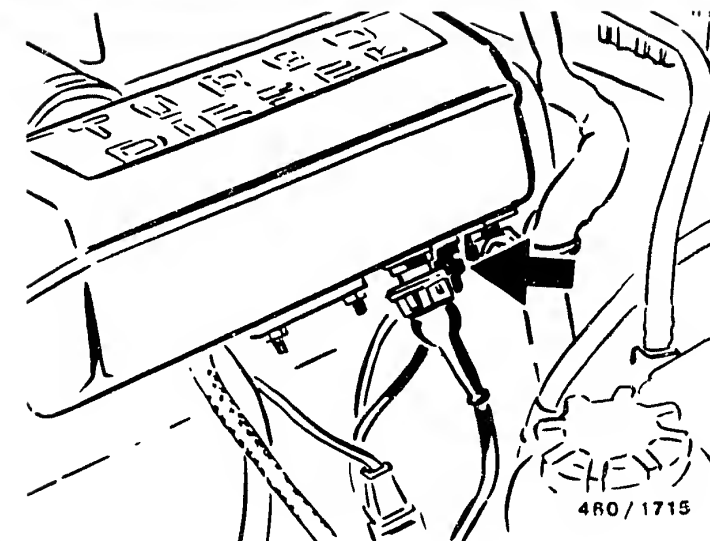
Measure resistance.

Set value:
see brief instructions

Set value attained?

V

Continued on next picture page



SELF-DIAGNOSIS TEST PROGRAM (1) (CONTINUED 1)

Check plug for corrosion and loose contact.
It must not be possible to push back contacts.

N>

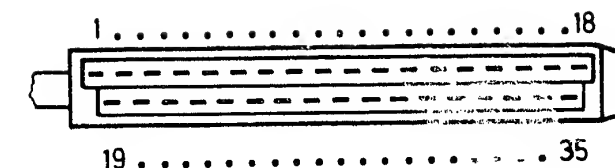
Repair defective lead/plug; renew control unit 1 if necessary.

Check leads:
From control unit 1 term. 23 and term. 35 to temperature sensor term. 2 and term. 1 for open-circuit.

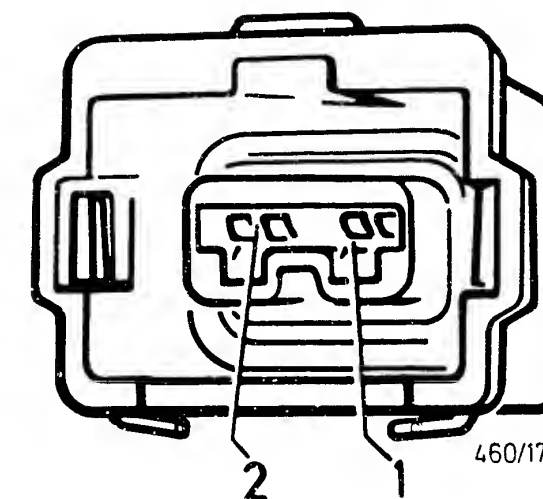
From control unit 1 term. 23 to temperature sensor term. 2 for short-circuit to positive.

Use multimeter with test leads KDZS 0004.

Set value attained?



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Return to self-diagnosis test table B16

B21

<=>

B22

<=>

SELF-DIAGNOSIS TEST PROGRAM (2)

Temperature sensor
Engine
Short to ground
Fault code: 3
(Flashing code: 1)

N>

Renew engine temperature sensor.

Detach plug (picture, top.
Temperature sensor not visible in
picture).

Connect multimeter with test leads
KDUM 0005.
Perform measurement between each
temperature-sensor terminal post
and ground.

Measure resistance.

Set value: > 1 M Ω

Set value attained?

Y
V

Check leads:

N>

Repair defective leads; renew
control unit 1 if applicable.

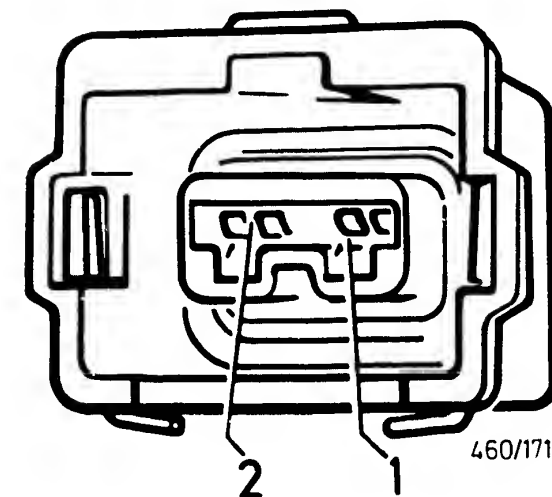
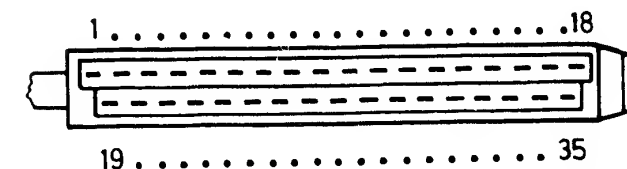
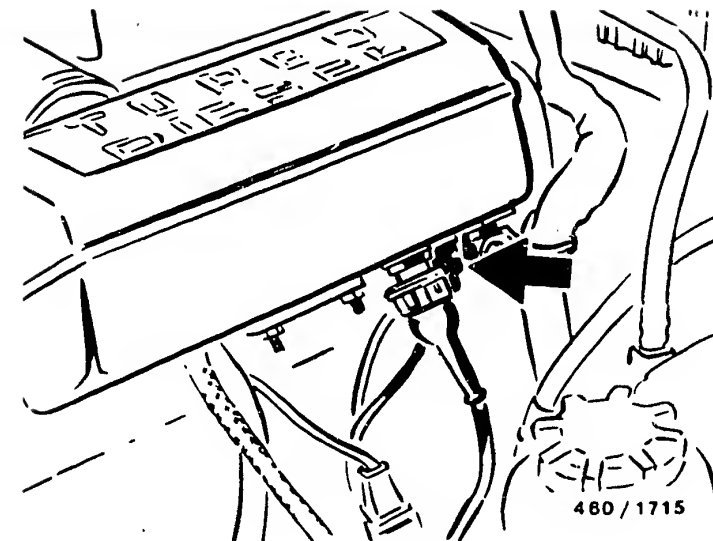
From control unit 1 term. 23
to
temperature sensor term. 2 for
short to ground,
from control unit 1 term. 23 and
term. 35 to
temperature sensor term. 2 and
term. 1 for short-circuit.

Use multimeter with test leads
KDZS 0004.

Set value attained?

V

Return to self-diagnosis
test table B16



SELF-DIAGNOSIS TEST PROGRAM (3)

Speed signal
sensor
Incorrect/no signal
Fault code: 9
(Flashing code: 7)

Test prerequisite: correct speed
indication.

Disconnect plug connection of
engine plug (top picture, arrow).
Connect multimeter with commer-
cially available test leads and
test prods to engine plug,
socket 14 and ground.

Switch on ignition.

Measure voltage.

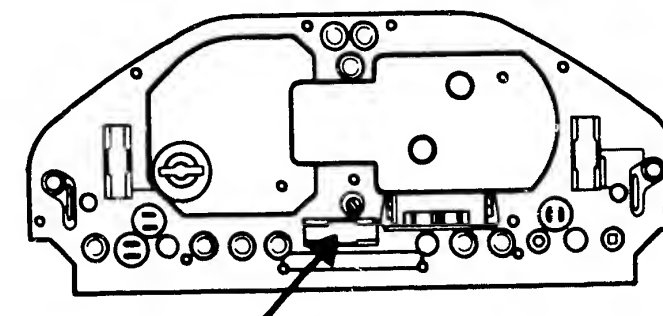
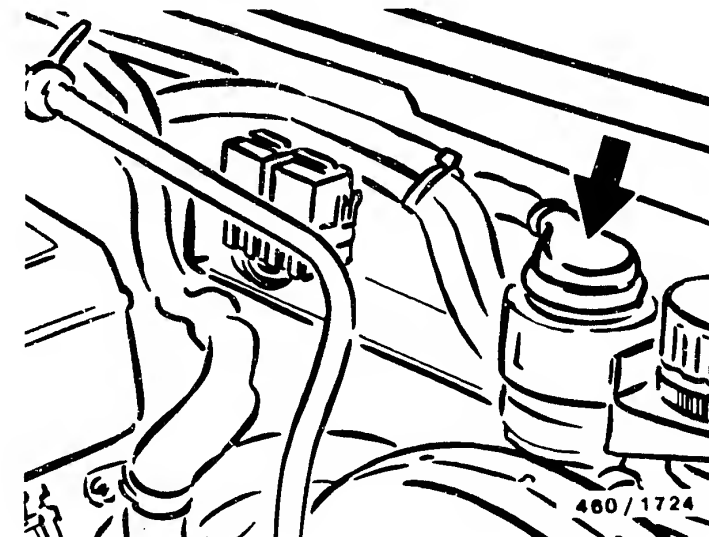
Set value: > 4.5 V

Set value attained?

N>

Repair defective lead.
From socket 14, engine plug to
plug, instrument cluster term. 26
(center picture, arrow).

If the fault is still present after
eliminating the lead open-circuit,
renew instrument cluster.



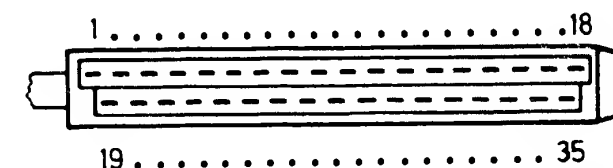
Detach plug, control unit 1.
Check lead for open-circuit:
From plug, control unit 1, term. 9
to engine plug, socket 14.

Set value: approx. 0 Ω

If set value is attained,
renew control unit 1.

N>

Repair defective lead.



Continued on next picture page

SELF-DIAGNOSIS TEST PROGRAM (3) (CONTINUED 1)

Test prerequisite: no speed indication

N>

Renew speed sensor.

Jack up rear of vehicle, one drive wheel must be able to turn freely. Connect analog multimeter with test leads KDUM 0007 to speed sensor (picture, arrow). Make mark on wheel (e.g. with chalk). Slowly turn wheel once.

Set value: 9 pointer deflections per wheel revolution

Set value attained?

Y

Y

Check lead connection between speed sensor and instrument cluster for open-circuit/contact resistance.

N>

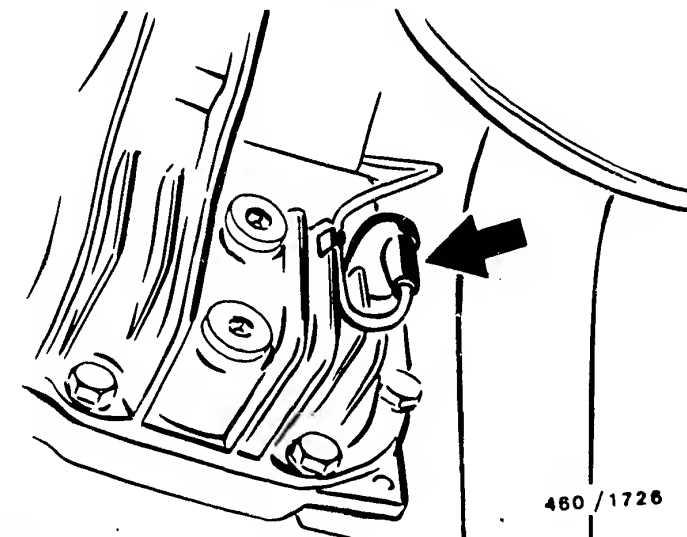
Repair defective lead.

Set value: approx. 0 Ω

If set value is attained, renew instrument cluster.

Y

Return to self-diagnosis test table B16



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SELF-DIAGNOSIS TEST PROGRAM (4)

V

Cruise-control
operating unit
Open-circ./short circ.
Fault code: 10
(Flashing code: 3)

N>

Renew cruise-control operating unit.

Disconnect plug connection.

Connect multimeter with test leads
KDZS 0004 to plug term. 1 and
term. 4 .

Switch through following positions
on cruise-control operating unit:

- Neutral (0)
- Reactivate (1)
- Set (accelerate) (2)
- Set (decelerate) (3)
- Off (4)

Measure resistance.

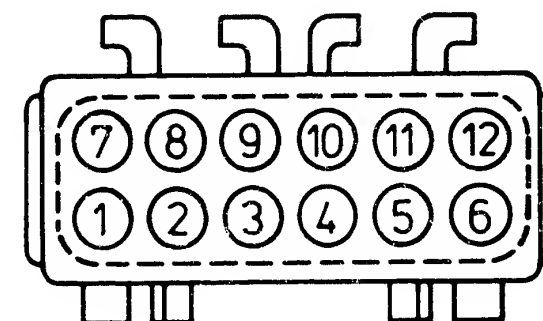
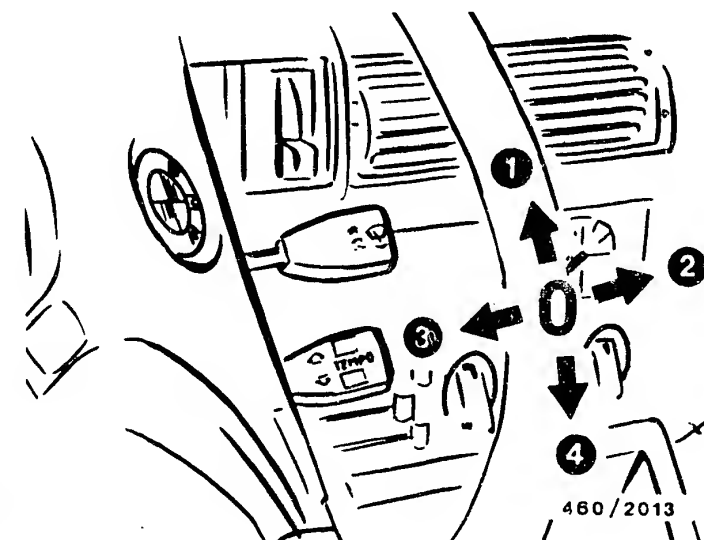
Set values: see brief instructions

Set value attained?

Y

V

Continued on next picture page



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V

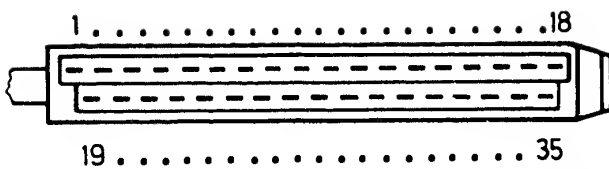
Check plug for corrosion and loose contact.
It must not be possible to push back contacts.

Check leads:
from control unit 1 term. 26 and term. 35 to
cruise-control operating unit term. 4 and term. 1 for open-circuit.
From control unit 1 term. 26 to cruise-control operating unit term. 4 for short-circuit to positive.

Use multimeter with test leads KDZS 0004.

N>

Repair defective leads/plugs, renew control unit 1 if applicable.

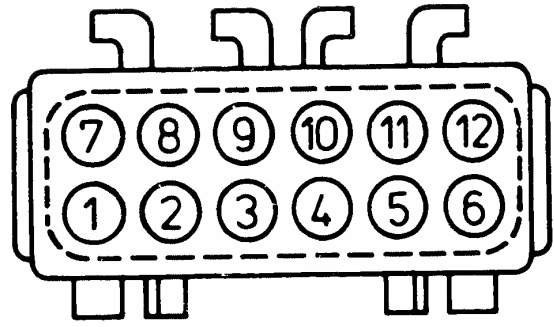


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Y



Return to self-diagnosis test table B16



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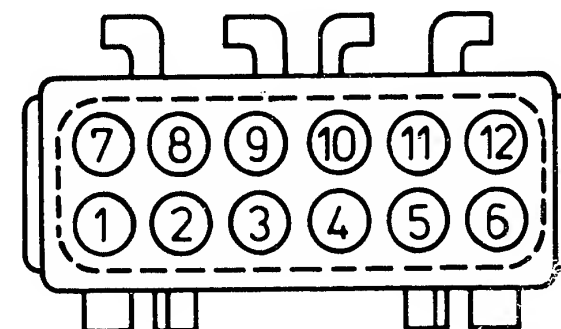
SELF-DIAGNOSIS TEST PROGRAM (5)

V

Cruise-control operating unit
Short to ground
Fault code: 10
(Flashing code: 3)

N>

Renew cruise-control operating unit.



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Disconnect plug connection (top picture).
Connect multimeter with test leads KDZS 0004 to plug term. 1 and term. 4.

Switch through following settings on cruise-control operating unit:
- Neutral (0)
- Reactivate (1)
- Set (accelerate) (2)
- Set (decelerate) (3)
- Off (4)

Measure resistance.

Set values: see brief instructions

Set values attained?

V

Check leads:

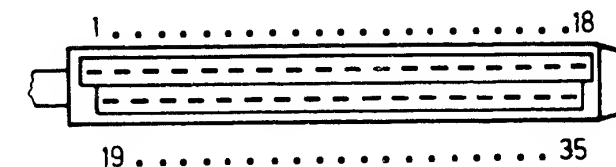
N>

Repair leads, renew control unit 1 if applicable.

From control unit 1 term. 26 to cruise-control operating unit term. 4 for short to ground.
From control unit 1 term. 26 and term. 35 to cruise-control operating unit term. 4 and term. 1 for short-circuit.

V

Return to self-diagnosis test table B16



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C05

<=>

C06

<=>

SELF-DIAGNOSIS TEST PROGRAM (6)

V

Interface
Computer communication
faulty
Fault code: 11
(Flashing code: 5)

N>

Repair defective lead/plugs.

Test instruction:
Fault is not present when performing test; particular attention is therefore to be paid to:

- * Loose contacts at plug connections.
- * Dirty, corroded or pushed-back plug contacts.
- * Broken wires in the event of kinking or crushing.

Switch off ignition.

Detach connectors at control unit 1 and 2.

Connect multimeter with test leads KDZS 0004 to terminals listed below.

Control unit 1	Control unit 2
Term. 14	and term. 9
Term. 15	and term. 12

Move connecting leads of control units during test.

Measure resistance.

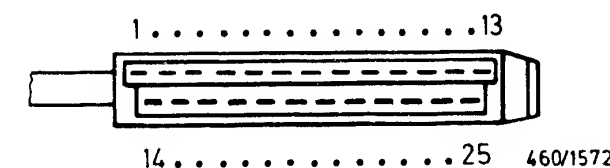
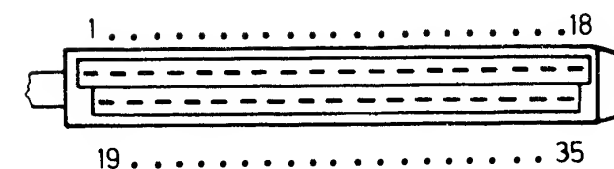
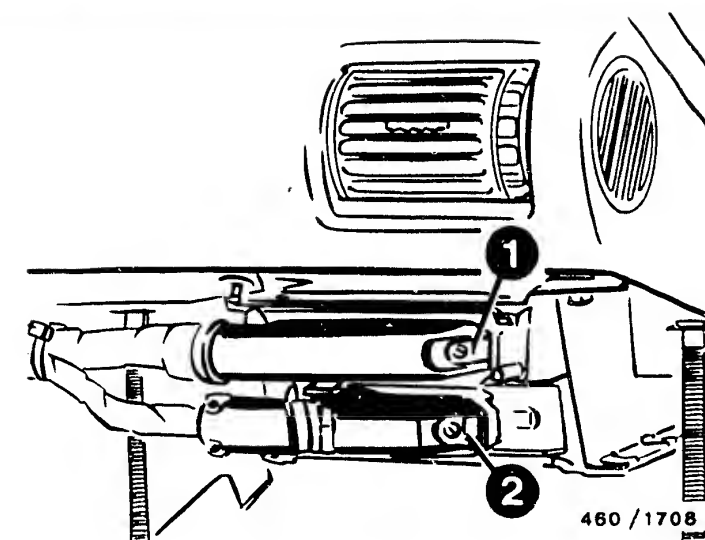
Set value: approx. 0 Ω

Set value attained?

Y

V

Continued on next picture page



SELF-DIAGNOSIS TEST PROGRAM (6) (CONTINUED 1)

V

Connect connector to control unit.

Switch on ignition.

Start engine and allow it to idle.

Activate self-diagnosis.

No fault indication (fault code 11,
computer-communication interface
O.K.)

Switch off engine.

N>

Detect defective control unit
by exchanging.

Y

V

Return to self-diagnosis
test table B16

C09

<==>

C10

<==>

SELF-DIAGNOSIS TEST PROGRAM (7)

Interface
Computer communication
faulty

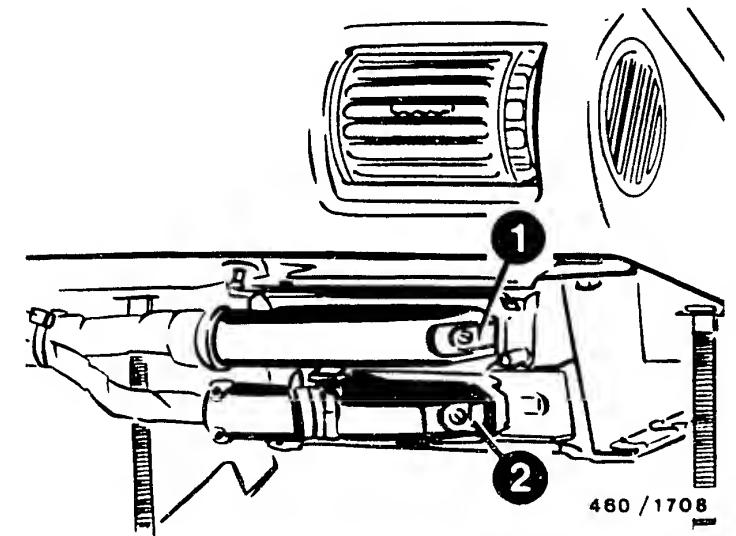
N>

Renew control unit 1 (top picture).

Control unit 1
Computer monitoring

Fault code/flashing code (11/5)
may possibly not be indicated.

Can the engine be started and
run at any arbitrary speed?



Return to self-diagnosis
test table B16

C11

<=>

C12

<=>

SELF-DIAGNOSIS TEST PROGRAM (8)

Interface
Computer communication
faulty

N>

Renew control unit 2.

Following renewal, interrogate
fault memory.
Fault code 11 is displayed.

Control unit 2
Computer monitoring

Test prerequisite:
Interrogate fault memory.
No fault stored.

Test: Measurement voltage
Control unit 2

Disconnect multiple butt
connector (top picture, arrow) of
start-of-injection solenoid valve.

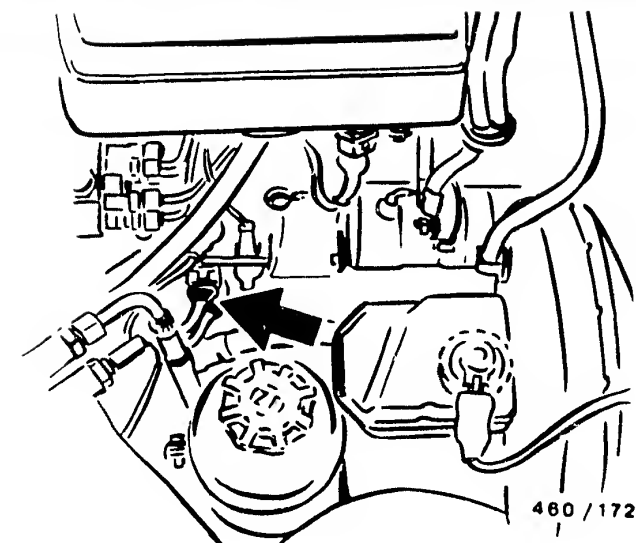
Connect multimeter with test leads
and test prods to disconnected
connector term. 1 and ground.

Measure voltage.

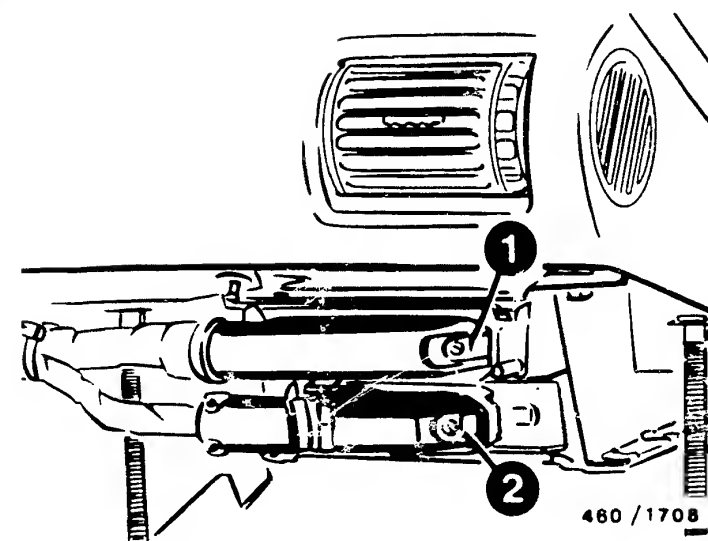
Switch on ignition.

Set value approx. 12 V

Set value attained?



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Return to self-diagnosis
test table B16

C13

<=>

C14

<=>

SELF-DIAGNOSIS TEST PROGRAM (9)

V

Temperature sensor
Air
Op.-circ/sh.-circ to pos.
Fault code: 12
(Flashing code: 6)

N>

Renew air temperature sensor.

Detach plug (picture, top).

Connect multimeter with test leads
KDUM 0008 to temperature sensor.

Measure resistance.

Set value: see brief instructions

Set value attained?

Y
V

Check plug for corrosion and
loose contact.
It must not be possible to push back
contacts.

N>

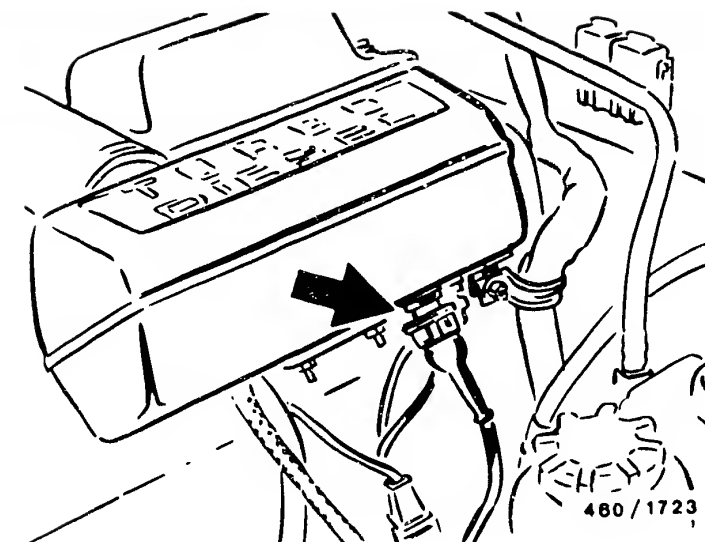
Repair defective lead/plugs; renew
control unit 2 if necessary.

Check leads:
from control unit 2 term. 4 and
term. 17 to temperature sensor
term. 1 and term. 2 for open-circuit.
From control unit 2 term. 17
to
temperature sensor term. 2 for
short-circuit to positive.
Use multimeter with test leads
KDZS 0004.

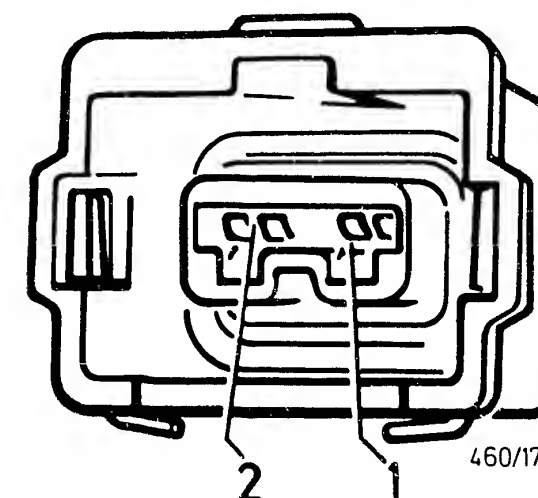
Set value attained?

V

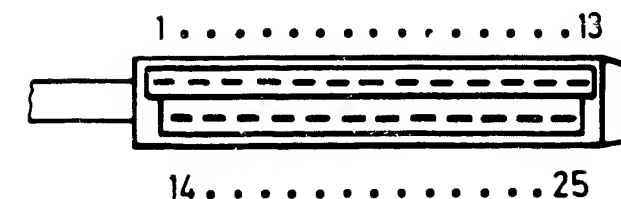
Return to self-diagnosis
test table B16



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460/1717



460/1575

SELF-DIAGNOSIS TEST PROGRAM (10)

Temperature sensor
Air
Short to ground
Fault code: 12
(Flashing code: 6)

N>

Renew air temperature sensor.

Detach plug (picture, top).

Connect multimeter with test leads
KDUM 0008 to temperature sensor.

Measure resistance.

Set value: see brief instructions

Set value attained?

Y
V

Check leads:
from control unit term. 17
to
temperature sensor term. 2 for
short to ground.
From control unit 2 term. 4 and
term. 17 to
temperature sensor term. 2 and
term. 1 for short-circuit.

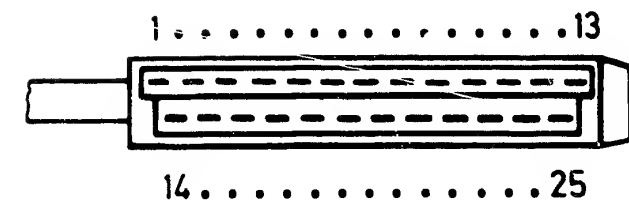
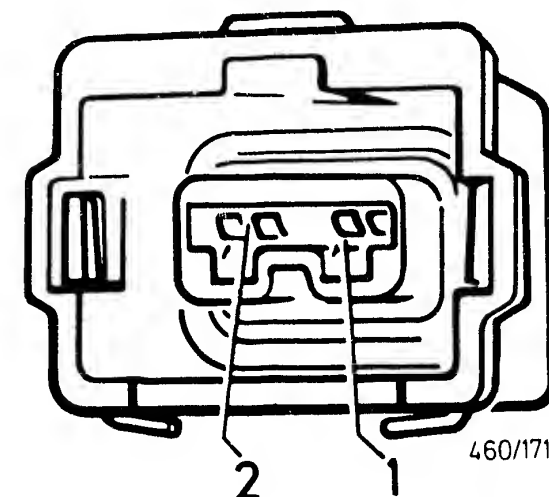
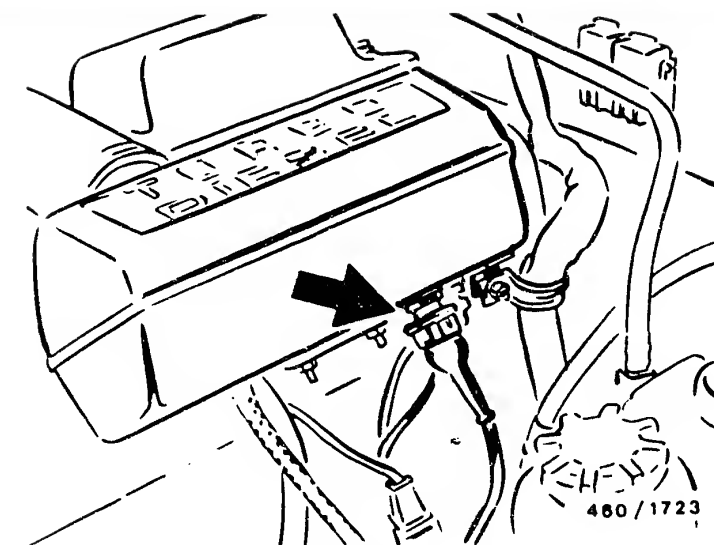
N>

Repair defective lead/plugs; renew
control unit 2 if necessary.

Use multimeter with test leads
KDZS 0004.

Y
V

Return to self-diagnosis
test table B16



C17

<=>

C18

<=>

SELF-DIAGNOSIS TEST PROGRAM (11)

↓

Speed sensor

Open-circ/short to ground

Fault code: 129

(Flashing code: 14)

N>

Renew speed sensor (top picture).

Detach plug connection.

Connect multimeter with test leads
KDUM 0008 to term. 1 and
term. 2.

Measure resistance.

Set value: see brief instructions

Connect multimeter with test leads
KDUM 0008 to term. 1 and term. 3.

Measure resistance.

Set value: $> 1 \text{ M } \Omega$

Connect multimeter with test lead
KDUM 0008 to term. 1 and with
commercially available test lead
to ground.

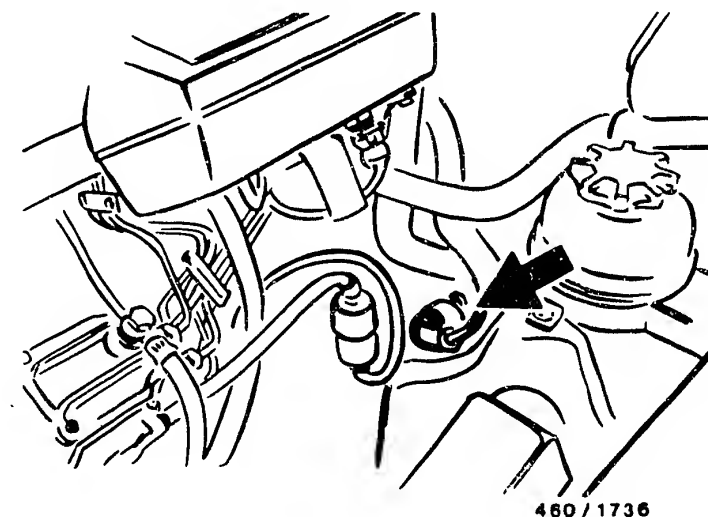
Measure resistance.

Set value: $> 1 \text{ M } \Omega$

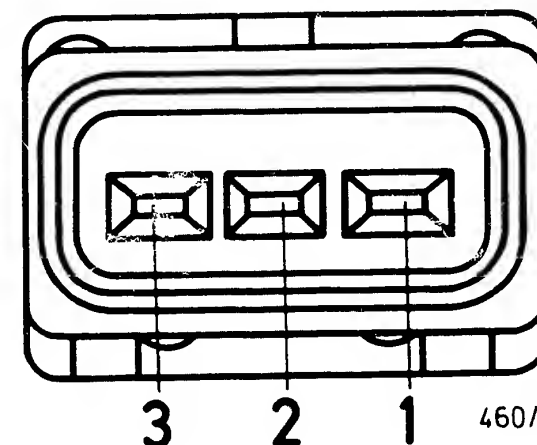
Set values attained?

Y
-V

Continued on next picture page



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SELF-DIAGNOSIS TEST PROGRAM (11) (CONTINUED 1)

Check plug for corrosion and loose contact.
It must not be possible to push back contacts.

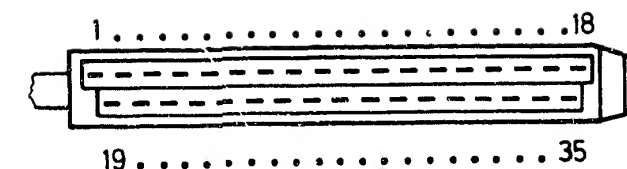
N>

Repair defective leads and plugs;
renew control unit 1 if necessary.

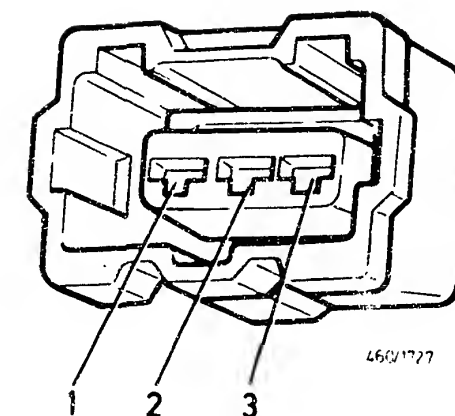
Check leads:
from control unit 1 term. 31 and term. 35 to speed sensor term. 1 and term. 2 for open-circuit.
From control unit 1 term. 31 to speed sensor term. 1 for short to ground.
From control unit 1 term. 31 and term. 35 to speed sensor term. 1 and term. 2 for short-circuit.

Use multimeter with test leads KDZS 0004.

Are set values attained?



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Return to self-diagnosis
test table B16

C21

<==>

C22

<==>

SELF-DIAGNOSIS TEST PROGRAM (12)

V

Speed sensor

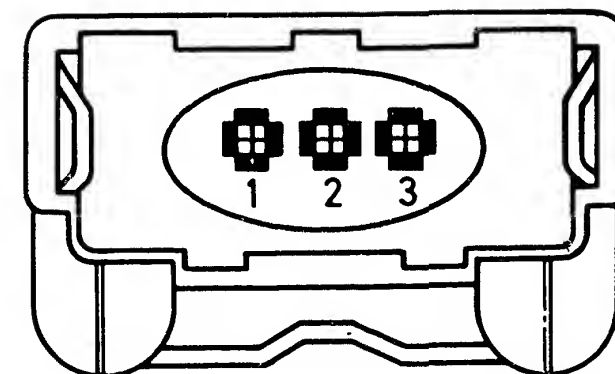
Incorrect signal
Fault code: 129

N>

Repair leads and plugs.

Deviating signal pattern:

- Speed pulses missing.
Not more than 1 pulse may be missing or appear garbled.
Possible causes of trouble:
one or more sensor pins missing.
- Too many speed pulses.
Possible causes of trouble:
(pseudo-sensors) on flywheel
(e.g. screws).



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Check plug for corrosion and loose contact.
It must not be possible to push back contacts.

Push back rubber sleeve at plug of speed sensor.

Connect MOT tester special input and terminal 15+ to plug term. 1.
Make ground connection.

MOT tester setting:
Special input 20 V, 100 ms.

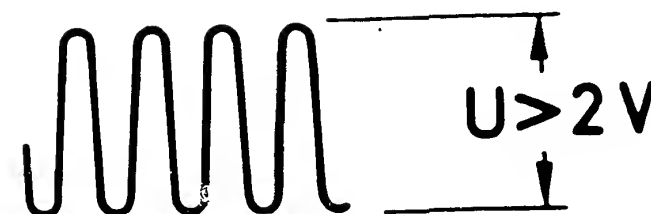
Run engine at idle speed.
Signal pattern must correspond to illustrated shape.

Note:
Not more than 1 pulse may be missing or appear garbled.

Is signal shape obtained?

Y
V

Return to self-diagnosis
test table B16



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SELF-DIAGNOSIS TEST PROGRAM (13)

Temperature sensor
Fuel
Op.-circ/sh.-circ to pos.
Fault code: 130
(Flashing code: 4)

N>

Disconnect plug connection
(picture, top).

Connect test adapter KDEP 1165
with adapter lead KDEP 1165/300
to connecting lead to fuel-injection
pump.

Connect multimeter with commercially
available test leads to measurement
sockets 5 and 6 (picture, center).

Measure resistance.

Set value:
see brief instructions

Set value attained?

Remove cover from quantity actuator.
Perform resistance measurement with
commercially available measurement
leads and test prods directly at
component (bottom picture).

Set value: see brief instructions

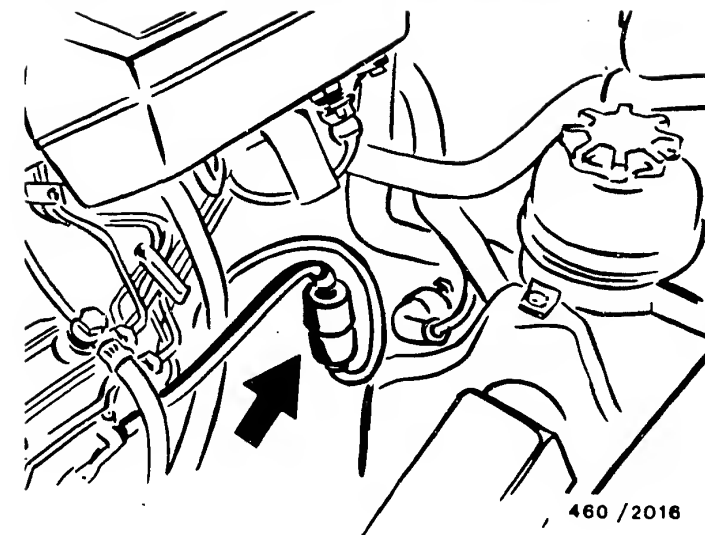
If actual value deviates from set
value, renew temperature sensor.

Repair information

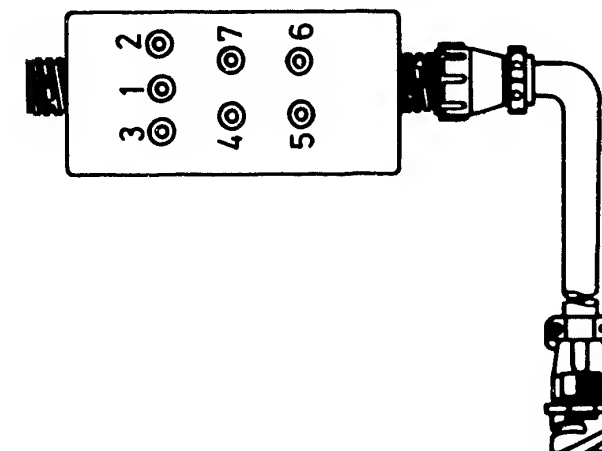
(m u s t b e observed)

- Catch fuel after removing cover
of quantity actuator
- Fit cover plate KDEP 1180
- Unscrew fillister-head screws
at temperature sensor
- Renew temperature sensor using
taper-nose pliers; contact must
not be made with wiper and
potentiometer track
- Tightening torque of fillister-
head screws 0.5...1 Nm
- Fit cover of quantity actuator
and tighten fastening screws
to a tightening torque of
7...10 Nm

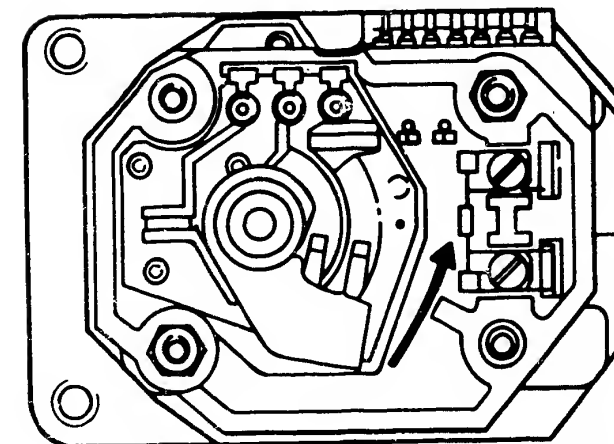
If set value is attained, remove
fuel-injection pump and renew
quantity actuator.



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Continued on next picture page

SELF-DIAGNOSIS TEST PROGRAM (13) (CONTINUED 1)

Check plug for corrosion and loose contact.
It must not be possible to push back contacts.

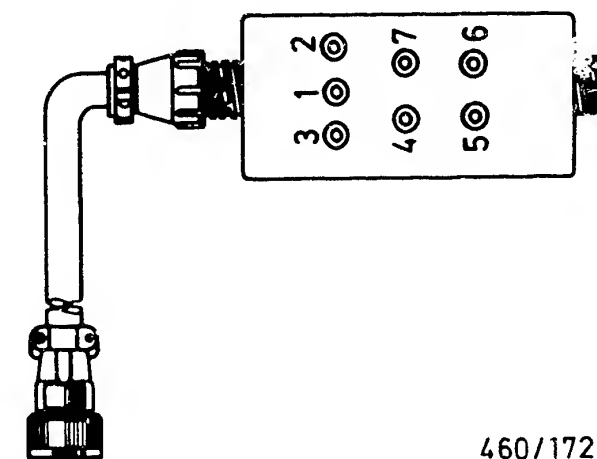
N>

Repair defective leads/plugs;
renew control unit 1 if necessary.

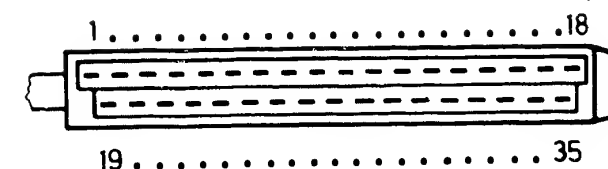
Attach test adapter KDEP 1165 with adapter lead KDEP 1165/301 to connecting lead to control unit.

Check leads:
from control unit term. 24 and term. 35 to test adapter KDEP 1165, socket 6 and socket 5 for open-circuit.
From control unit term. 24 to test adapter KDEP 1165, socket 6 for short-circuit to positive.
From control unit 1 term. 29, term. 24, term. 21 to test adapter KDEP 1165, sockets 2, 6, 4 for short-circuit.

Set values attained?



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Return to self-diagnosis
test table B16

C27

<=>

C28

<=>

SELF-DIAGNOSIS TEST PROGRAM (14)

Temperature sensor
Fuel
Short to ground
Fault code: 130
(Flashing code: 4)

N>

Disconnect plug connection
(top picture).

Attach test adapter KDEP 1165 with
adapter lead KDEP 1165/300 to
connecting lead to fuel-injection
pump.

Connect multimeter with commercially
available test leads to test
adapter KDEP 1165, socket 6 and
socket 5 (picture, bottom).

Measure resistance.

Set value: see brief instructions

Set value attained?

Remove cover from quantity actuator.
Perform resistance measurement with
commercially available measurement
leads and test prods directly at
component (bottom picture).

Set value: see brief instructions

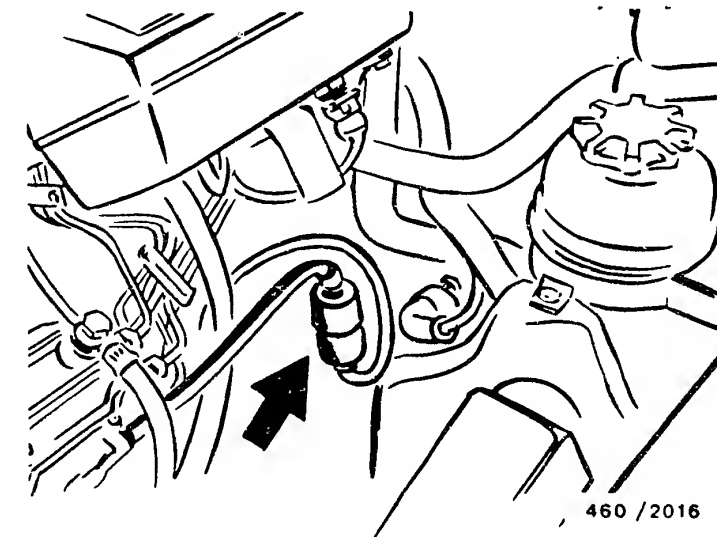
If actual value deviates from set
value, renew temperature sensor.

Repair information

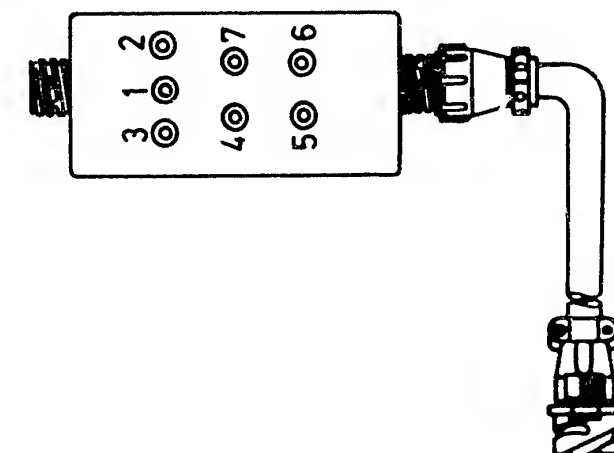
(m u s t b e o b s e r v e d)

- Catch fuel after removing cover
of quantity actuator
- Fit cover plate KDEP 1180
- Unscrew fillister-head screws
at temperature sensor
- Renew temperature sensor using
taper-nose pliers; contact must
not be made with wiper and
potentiometer track
- Tightening torque of fillister-
head screws 0.5...1 Nm
- Fit cover of quantity actuator
and tighten fastening screws
to a tightening torque of
7...10 Nm

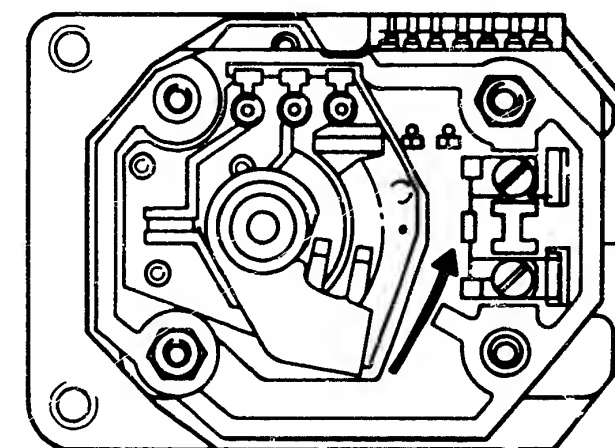
If set value is attained, remove
fuel-injection pump and renew
quantity actuator.



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Continued on next picture page

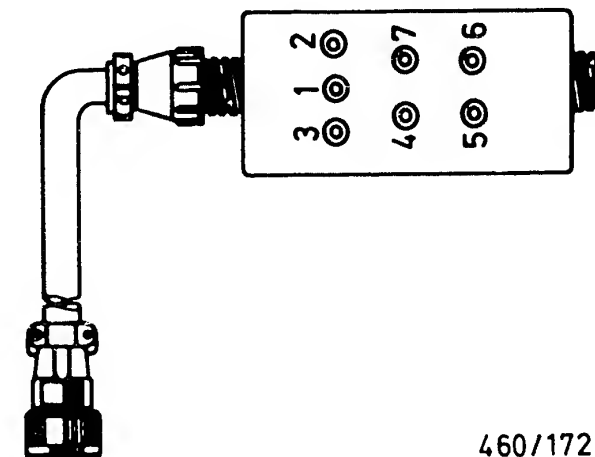
SELF-DIAGNOSIS TEST PROGRAM (14) (CONTINUED 1)

Connect test adapter KDEP 1165 with adapter lead KDEP 1165/301 to disconnected plug to control unit.

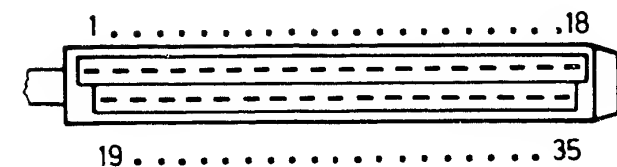
Check leads:
from control unit 1 term. 24 to test adapter KDEP 1165, socket 6 for short to ground.
From control unit 1 term. 24, term. 35, term. 10 to test adapter KDEP 1165, socket 6, 5, 3 for short-circuit.

Set values attained?

Repair leads; renew control unit 1 if necessary.



460/1721



460/1573

Return to self-diagnosis test table B16

D03

<=>

D04

<=>

SELF-DIAGNOSIS TEST PROGRAM (15)

Throttle sensor
Potentiometer
Signal too high
Fault code: 132
(Flashing code: 2)

N>

Renew throttle sensor. Pay attention
to installation instructions.

Disconnect plug connection of
throttle sensor (top picture).

Connect multimeter with commercially
available test leads and test prods
to throttle sensor term. 1 and
term. 4 as well as term. 2 and
term. 4.

Accelerator pedal in idle position.

Measure resistances.

Set values: see brief instructions

Set values attained?

Y

V

Check leads:

N>

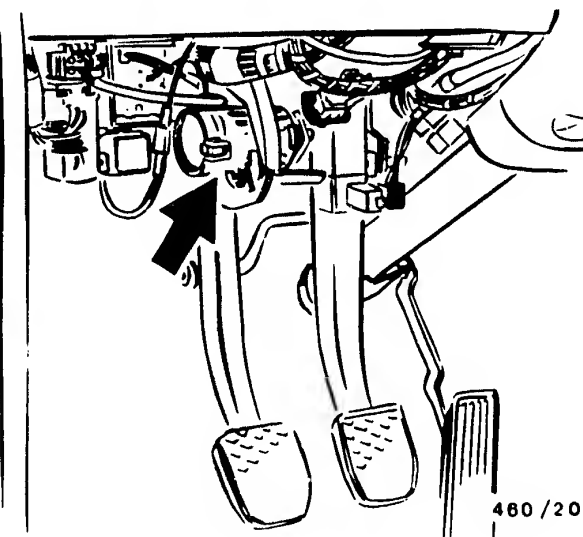
from control unit 1 term. 13 to
throttle sensor term. 1 for short-
circuit to positive.
From control unit 1 term. 17 and
term. 13 to throttle sensor
term. 2 and term. 1 for short-
circuit.

Set values attained?

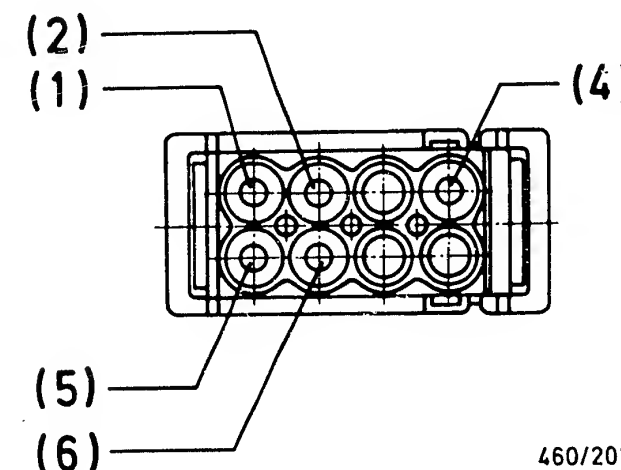
Y

V

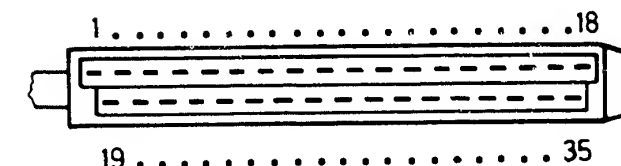
Return to self-diagnosis
test table B17



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SELF-DIAGNOSIS TEST PROGRAM (16)

Throttle sensor
Potentiometer
Signal too low
Fault code: 132
(Flashing code: 2)

N>

Renew throttle sensor. Pay attention
to installation instructions.

Disconnect plug connection of
throttle sensor (top picture).

Check plug for corrosion and
loose contact.
It must not be possible to push
back contacts.

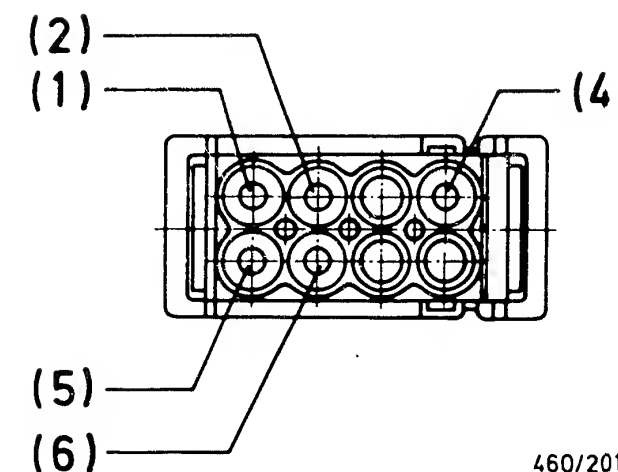
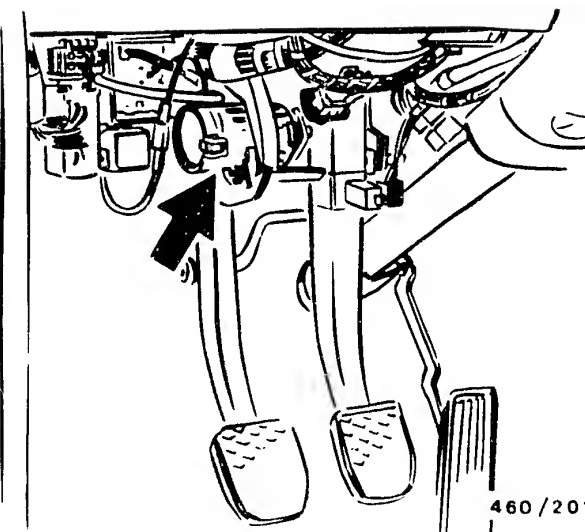
Connect multimeter with commercially
available test leads and test prods
to throttle sensor term. 1 and
term. 4 as well as term. 2 and
term. 4.

Accelerator pedal in idle position.

Measure resistances.

Set values: see brief instructions

Set values attained?



Continued on next picture page

SELF-DIAGNOSIS TEST PROGRAM (16) (CONTINUED 1)

V

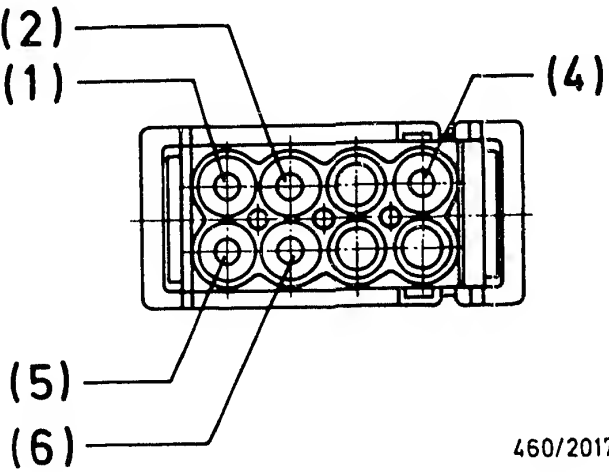
Check leads:
from control unit 1 term. 13 to
throttle sensor term. 1 for open-
circuit.
From control unit 1 term. 13 and
term. 10 to throttle sensor term. 1
and term. 4 for short-circuit.
Set values attained?

N>

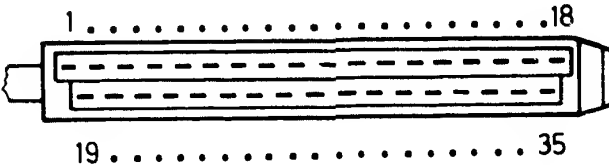
Repair leads; renew control unit 1
if applicable.

Y

Return to self-diagnosis
test table B17



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SELF-DIAGNOSIS TEST PROGRAM (17)

Throttle sensor
Potentiometer
Comparison not O.K.
Fault code: 132
(Flashing code: 2)

N>

Renew throttle sensor. Pay attention
to installation instructions.

Position comparison:
Throttle sensor to brake switch.

Connect multimeter (A) with
commercially available test leads
and test prods to plug, throttle
sensor term. 1 and term. 4.
Connect multimeter (B) with
commercially available test leads
and test prods to plug, throttle
sensor term. 4 and term. 5.

Switch on ignition.

Measure voltage. In doing so,
slowly move accelerator pedal from
idle position to full-throttle
position.

Set value: (A) see brief
instructions

Set value: (B) see brief
instructions.

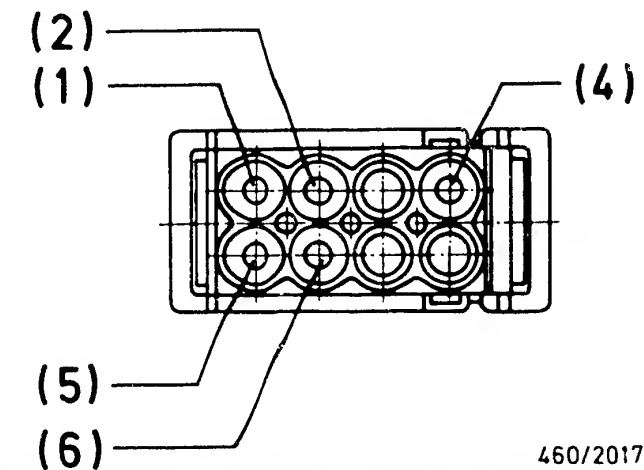
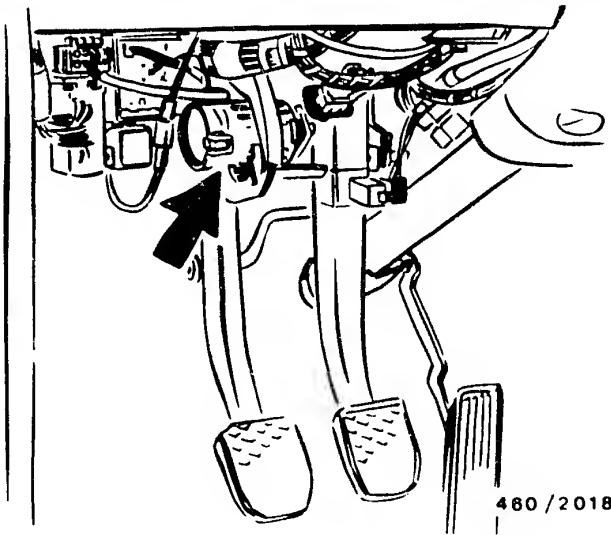
Voltage step change (B) must take
place with set value (A).

Set values attained?

Y

V

Continued on next picture page



Detach plug, control unit 1 and plug, throttle sensor.

Check plug for corrosion and loose contact.
It must not be possible to push back contacts.

Connect multimeter with test lead KDUM 0008 to plug, control unit 1 term. 12 and with commercially available test lead and test prod to plug, throttle sensor term. 5.

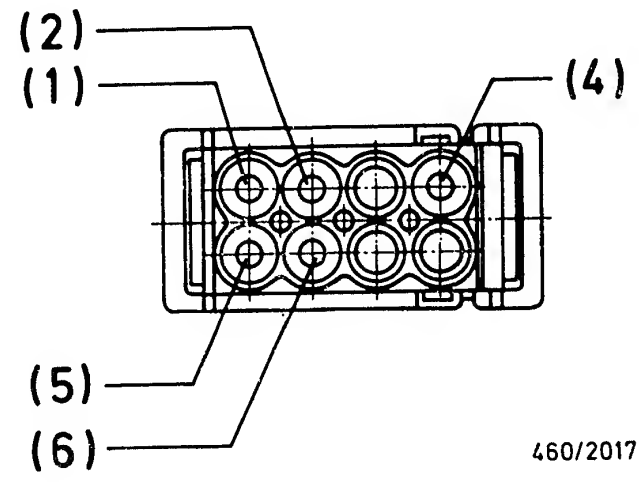
Measure resistance.

Set value: approx. 0 Ω

Set value attained?

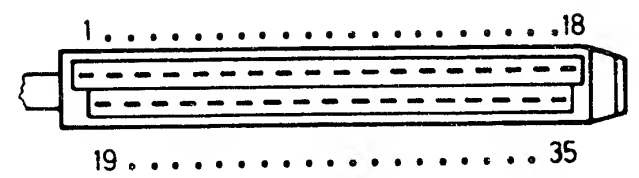
N>

Repair leads; renew control unit 1 if applicable.



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Return to self-diagnosis test table B17



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SELF-DIAGNOSIS TEST PROGRAM (18)

Dynamic throttle-sensor monitoring

Characteristic features:

- no fault indication (fault code/flashing code)
- high idle speed (safety speed, see brief instructions)
- following adjustment to safety speed, speed increase is possible (accelerate).

Perform the following check if, when driving, the characteristic features outlined occur above the safety speed after actuating the brake.

Freedom of movement of throttle-sensor actuator.

N>

Eliminate stiffness.

After actuating accelerator pedal, the throttle sensor must be heard to go back to the inner idle stop. Repeat test several times.

Function O.K.?

N>

Renew throttle sensor. Pay attention to installation instructions.

Return to self-diagnosis test table B17

SELF-DIAGNOSIS TEST PROGRAM (19)

V

Boost pressure sensor

Signal too high
Fault code: 133
(Flashing code: 8)

N>

Detach plug (top picture).

Connect multimeter with test leads
KDZS 0004 to plug, boost pressure
sensor term. 1 (+) and term. 3.

Switch on ignition.

Measure voltage.

Set value: 4.5...5.5 V

Set value attained?

Y

V

Continued on next picture page

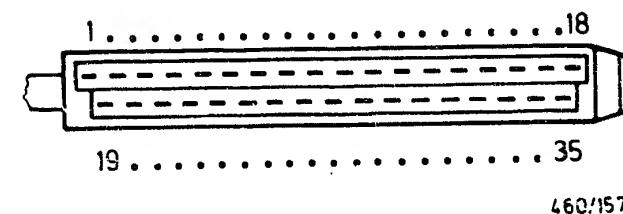
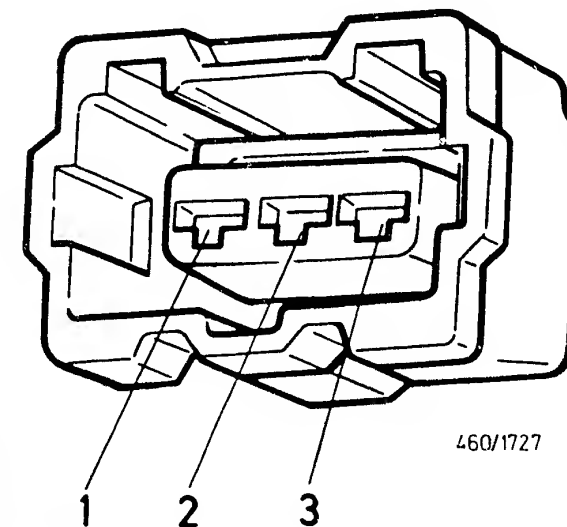
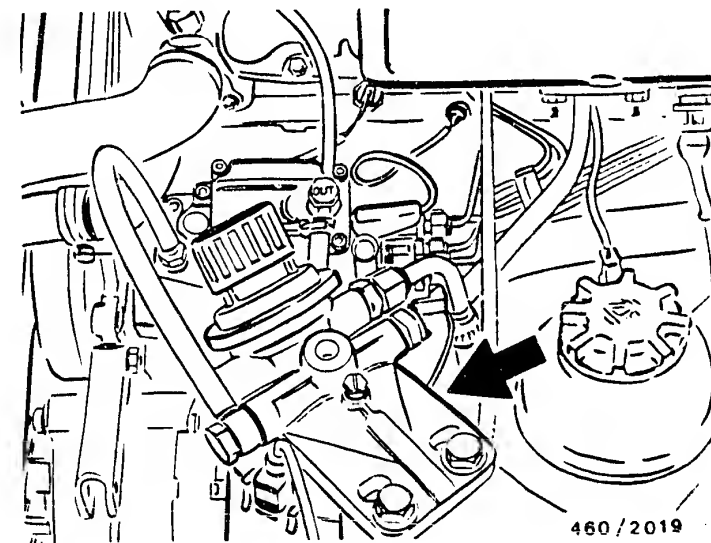
Check leads:

From plug, boost pressure sensor
term. 3 to plug, control unit 1
term. 35 for open-circuit.

From plug, boost pressure sensor
term. 1 to plug, control unit 1
term. 28 for short-circuit to
positive.

From plug, boost pressure sensor
term. 1 and term. 2 to plug,
control unit 1 term. 28 and term. 34
for short-circuit.

Renew control unit 1 if necessary.



SELF-DIAGNOSIS TEST PROGRAM (19) (CONTINUED 1)

Attach plug to boost pressure sensor.

Push back rubber sleeve.

Connect multimeter with test leads KDZS 0004 to plug, boost pressure sensor term. 2 and term. 3.

Switch on ignition.

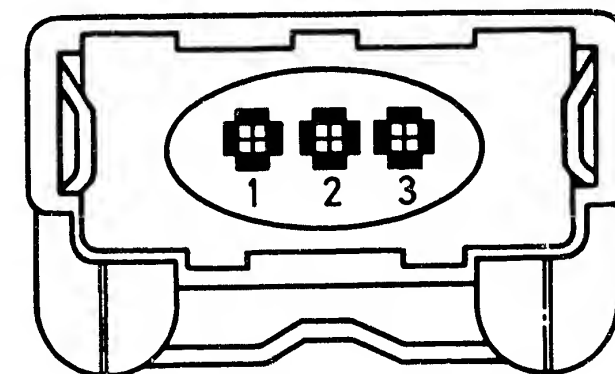
Measure voltage.

Set value: see characteristic curve

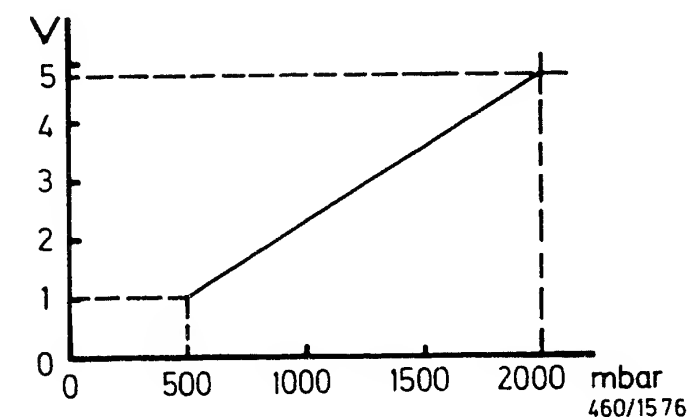
Set value attained?

N>

Renew boost pressure sensor.



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Return to self-diagnosis test table B17

D19

<=>

D20

<=>

Boost pressure sensor

Signal too low
Fault code: 133
(Flashing code: 8)

N>

Check plug for corrosion and loose contact.
It must not be possible to push back contacts.

Connect multimeter with test leads KDZS 0004 to plug, boost pressure sensor term. 1 (+) and term. 3.

Switch on ignition.

Measure voltage.

Set value: 4.5...5.5 V

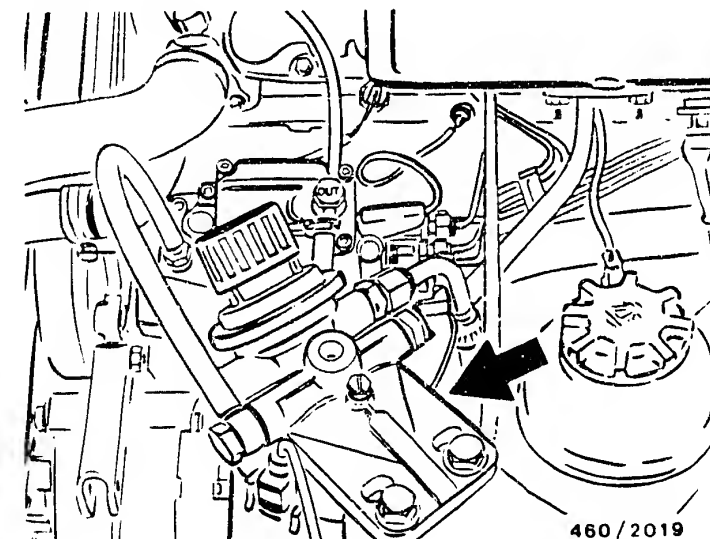
Set value attained?

Check leads:

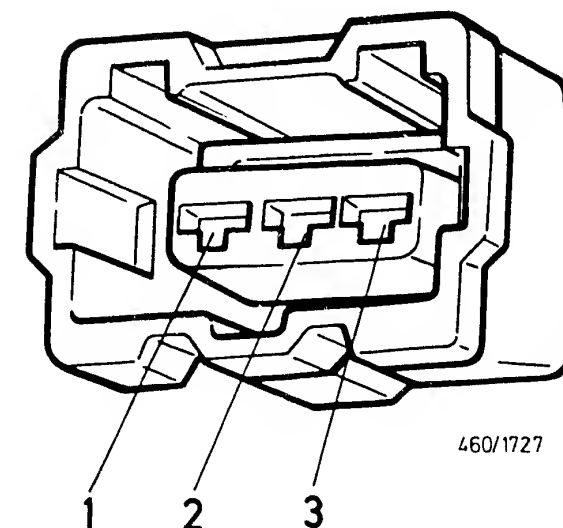
from plug, boost pressure sensor term. 1 to plug, control unit 1 term. 28 and from plug, boost pressure sensor term. 2 to plug, control unit 1 term. 34 for open-circuit.

From plug, boost pressure sensor term. 2 and term. 3 to plug, control unit 1 term. 34 and term. 35 for short-circuit.

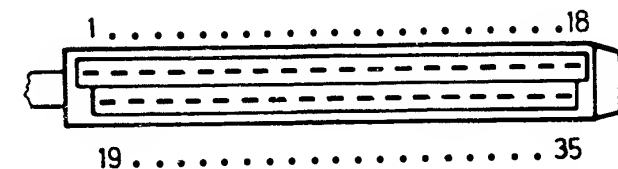
Renew control unit 1 if necessary.



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Continued on next picture page

SELF-DIAGNOSIS TEST PROGRAM (20) (CONTINUED 1)

Attach plug to boost pressure sensor.

Push back rubber sleeve.

Connect multimeter with test leads KDZS 0004 to plug, boost pressure sensor term. 2 and term. 3.

Switch on ignition.

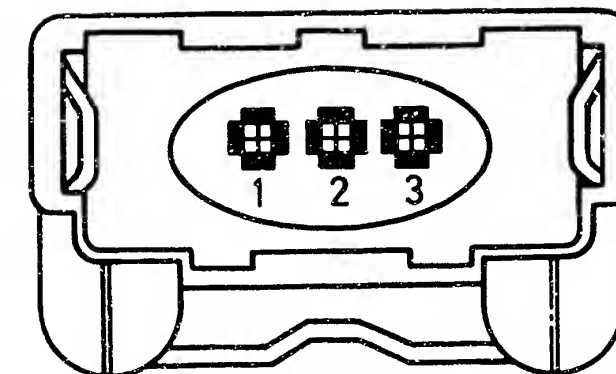
Measure voltage.

Set value: see characteristic curve

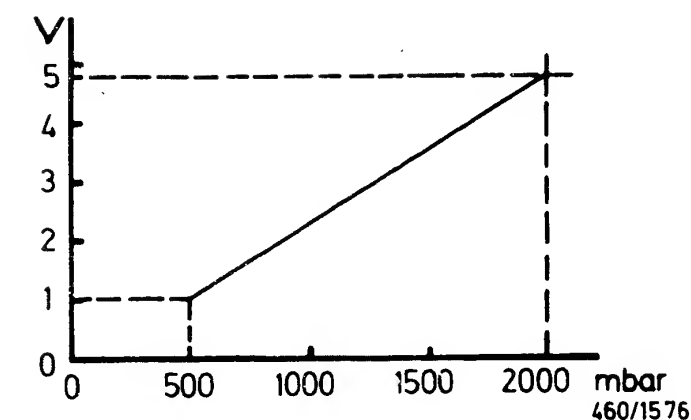
Set value attained?

N>

Renew boost pressure sensor.



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Return to self-diagnosis test table B17

SELF-DIAGNOSIS TEST PROGRAM (21)

Control-collar travel
sensor
Signal too high
Fault code: 134
(Flashing code: 12)

N>

Disconnect plug connection of fuel-
injection pump.

Check plug for corrosion and
loose contact.
It must not be possible to push
back contacts.

Connect test adapter KDEP 1165
with adapter leads KDEP 1165/301.

Connect multimeter with
commercially available test leads
to test adapter KDEP 1165, socket
2 (+) and 3.

Switch on ignition.

Measure voltage.

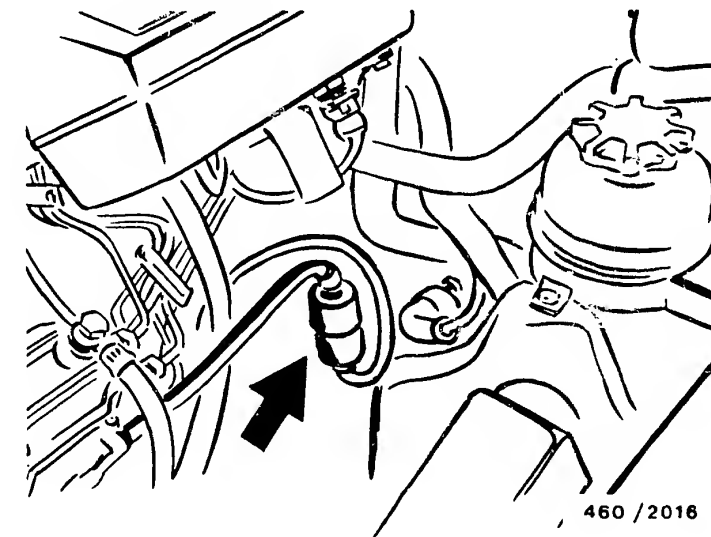
Set value: 4.5...5.5 V

Set value attained?

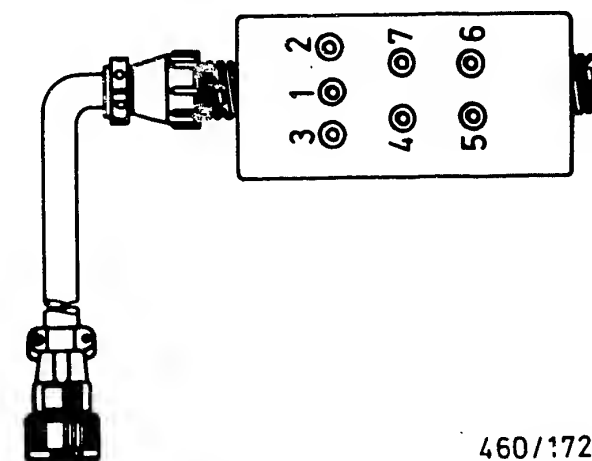
Check leads:

from plug, fuel-injection pump
term. 3 to plug, control unit 1
term. 10 for open-circuit.
From plug, fuel-injection pump
term. 2 to plug, control unit 1
term. 29 for short-circuit to
positive.
From plug, fuel-injection pump
term. 1 and term. 2 to plug,
control unit 1 term. 6 and term. 29
for short-circuit.

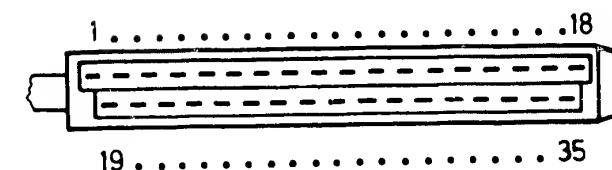
Renew control unit 1 if necessary.



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Continued on next picture page

SELF-DIAGNOSIS TEST PROGRAM (21) (CONTINUED 1)

Connect test adapter KDEP 1165 and adapter leads KDEP 1165/300 to fuel-injection-pump plug connection.

N> Renew quantity actuator.

Connect multimeter with commercially available test leads to test adapter KDEP 1165 socket 1 and ground, socket 2 and ground, socket 3 and ground.

Measure resistances.

Set values: > 1 M Ω

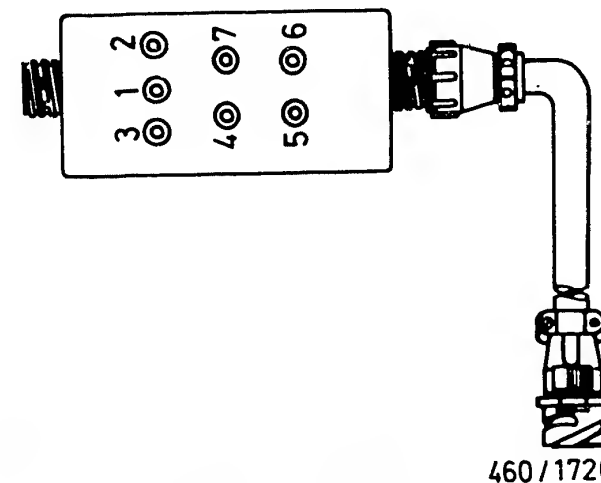
Connect multimeter with commercially available test leads to test adapter KDEP 1165 sockets 2 and 3 and then to sockets 1 and 3.

Measure resistances.

Set values: see brief instructions

Set values attained?

Return to self-diagnosis test table B17



SELF-DIAGNOSIS TEST PROGRAM (22)

Control-collar travel
sensor
Signal too low
Fault code: 134
(Flashing code: 12)

N>

Disconnect plug connection of
fuel-injection pump.

Connect test adapter KDEP 1165
with adapter leads KDEP 1165/301.

Connect multimeter with commercially
available test leads to test
adapter KDEP 1165, socket 2 (+)
and 3.

Switch on ignition.

Measure voltage.

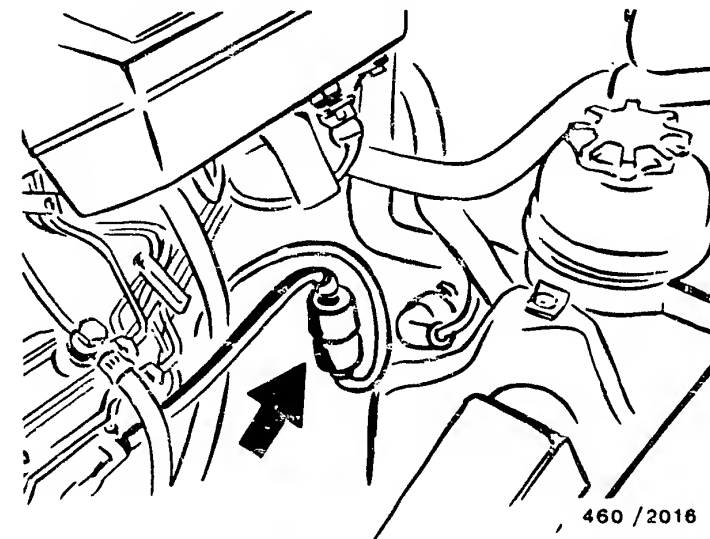
Set value: 4.5...5.5 V

Set value attained?

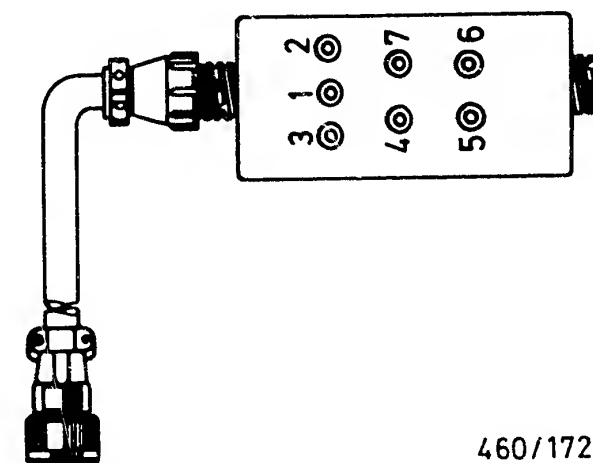
Check leads:

from plug, fuel-injection pump
term. 1 to plug, control unit 1
term. 6 for short to ground.
From plug, fuel-injection pump
term. 2, 3, 5 to plug, control unit
1 term. 6, 10, 35 for short-circuit.
From plug, fuel-injection pump
term. 1 and term. 2 to plug, control
unit 1 term. 6 and term. 29 for
short-circuit.

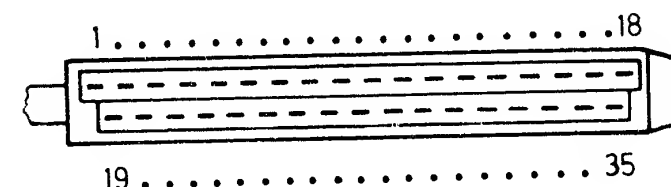
Renew control unit 1 if applicable.



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Return to self-diagnosis
test table B17

E01

<=>

E02

<=>

SELF-DIAGNOSIS TEST PROGRAM (23)

Control-collar travel
sensor
Comparison not O.K.
Fault code: 134
(Flashing code: 12)

N>

Repair defective plugs/leads.

Comparison of needle-movement-
sensor pulses with position of
control-collar travel sensor.

Test prerequisites:

- speed sensor
- needle movement sensor
- computer-communication interface
O.K..

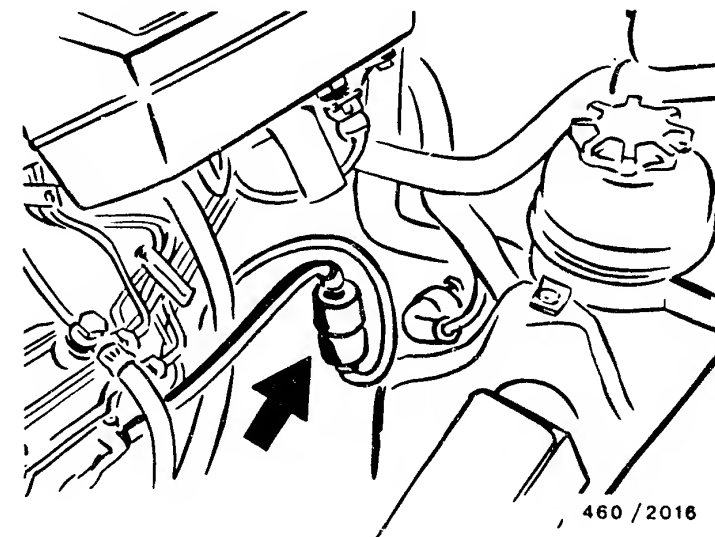
Characteristic feature: overrun
bucking

Check plug for corrosion and
loose contact.
It must not be possible to push
back contacts.

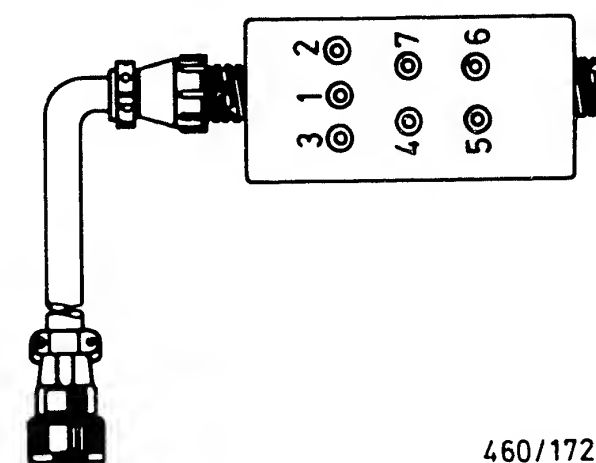
Connect test adapter KDEP 1165
with test lead KDEP 1165/301 to
plug, fuel-injection pump.

Check leads for open-circuit:
from plug, fuel-injection pump
term. 1,2,3 to plug, control unit 1
term. 6,29,10.

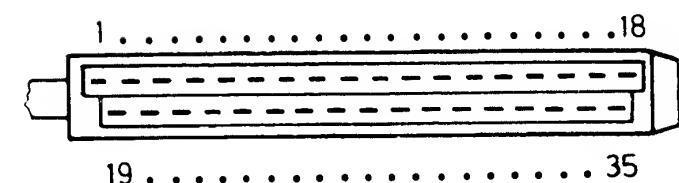
Set values attained?



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Continued on next picture page

E03

<=>

E04

<=>

SELF-DIAGNOSIS TEST PROGRAM (23) (CONTINUED 1)

Connect test adapter KDEP 1165
with test lead KDEP 1165/300 to
plug, fuel-injection pump.

Connect multimeter with commercially
available test leads to test adapter:
sockets 2 and 3 as well as
sockets 3 and 1.

Measure resistances.

Set values: see brief instructions

Set values attained?

N>

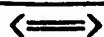
Remove cover at quantity actuator.
Perform visual inspection.
Remove any dirt.

Pay attention to cleanliness.

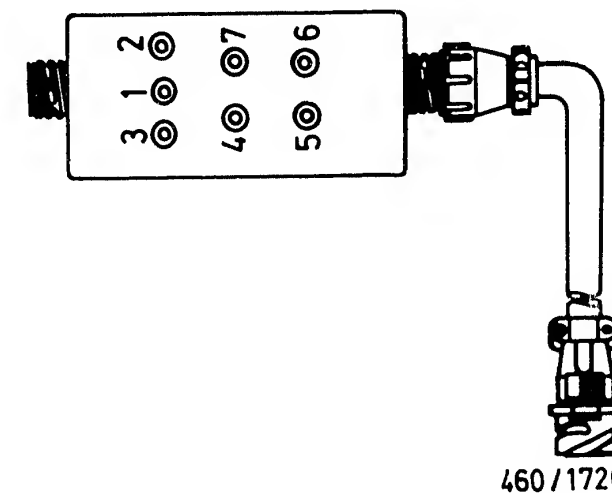
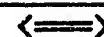
Renew fuel-injection pump if
applicable.

Return to self-diagnosis
test table B17

E05



E06



SELF-DIAGNOSIS TEST PROGRAM (24)

Turbocharger
Closed loop
faulty
Fault code: 135
(Flashing code: 9)

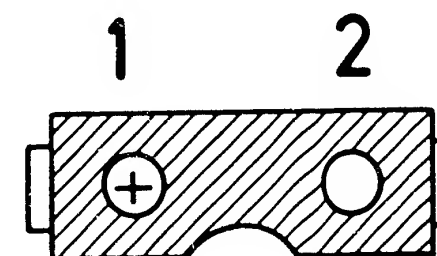
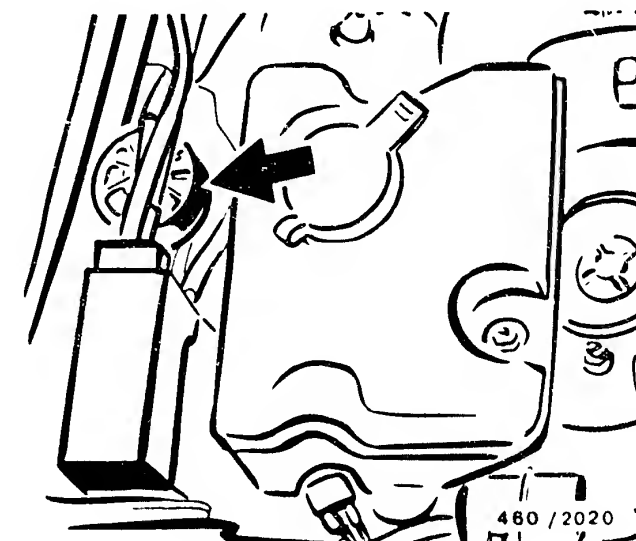
Detach plug (top picture).

Connect multimeter with commercially
available test leads to both
terminal posts of vacuum converter.

Set value at 0...120°C
4.5...8.0 Ω

Set value attained?

Replace electropneumatic
pressure transducer.



Connect multimeter with commercially
available test leads to plug term. 1
and ground (center picture).

Switch on ignition.

Measure voltage.

Set value: approx. 12 V

Set value attained?

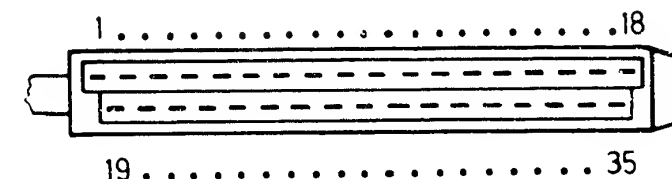
Switch off ignition.

Detach plug, control unit 1
(bottom picture) and check leads
from term. 1 and term. 25 to
vacuum converter with test leads
KDZS 0004 for open-circuit/contact
resistance.

Jumper leads at connector.

Set value approx. 0 Ω

If set value is attained, renew
control unit 1.



Continued on next picture page

SELF-DIAGNOSIS TEST PROGRAM (24) (CONTINUED 1)

Check laying of leads (top picture).
Check air filter of atmospheric vent
(bottom picture, 4).

N>

Adjust routing of lines.
Replace filter.

Connect pressure gauge to
connection 1 (top picture).

Run engine at idle speed.

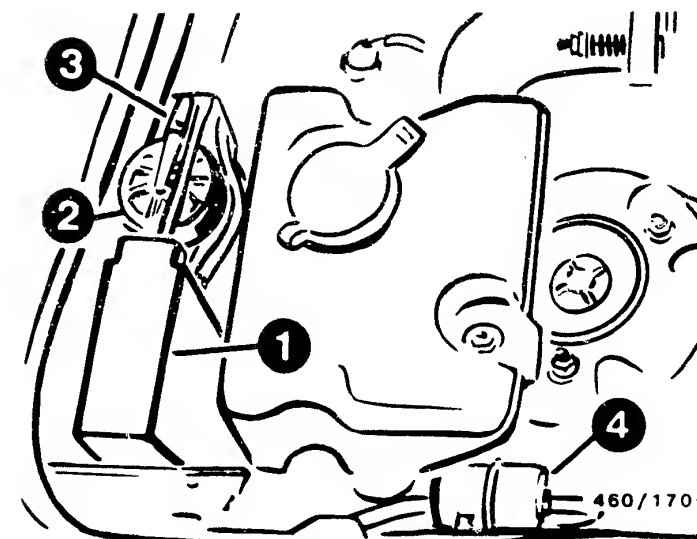
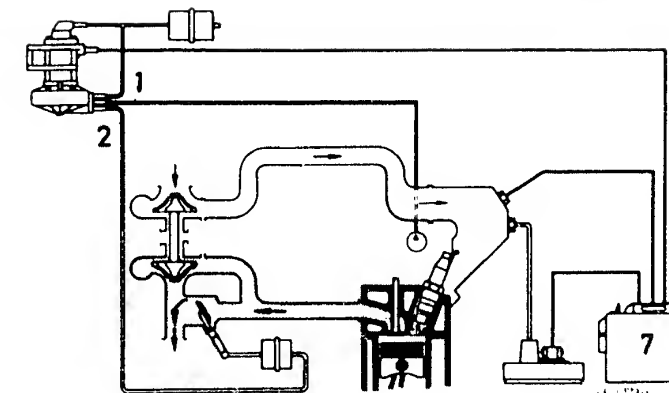
Set value: see brief instructions

Set value attained?

N>

If there is no vacuum, test
the hoses for leaks and
replace vacuum pump if
necessary.

If vacuum supply is present,
replace pressure transducer.



Continued on next picture page

SELF-DIAGNOSIS TEST PROGRAM (24) (CONTINUED 2)

Detach vacuum connection at control unit (picture, arrow).
Connect Mityvac pump and apply vacuum to control unit.

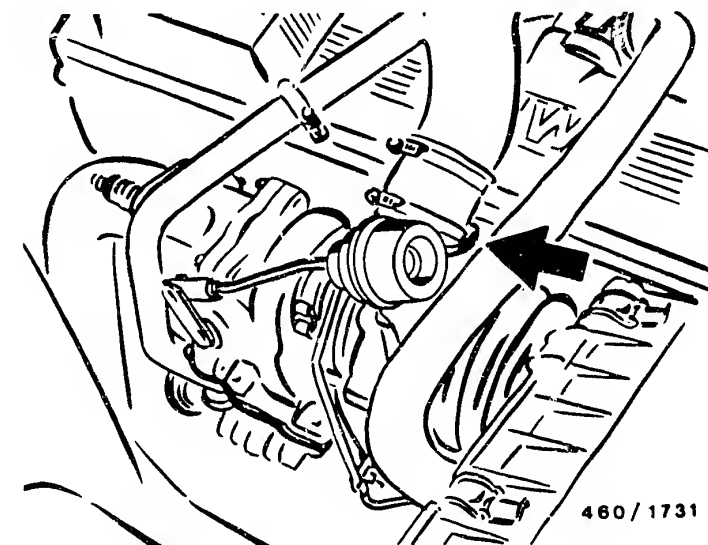
Can bypass flap be moved easily and quickly?

N> Replace turbo-supercharger.

Can mechanical running noise be clearly perceived during operation and in particular on changing load?
Can blue smoke be seen when driving with engine at operating temperature?

N> Replace turbo-supercharger.

Return to self-diagnosis test table B17



SELF-DIAGNOSIS TEST PROGRAM (25)

V

Quantity actuator
Closed loop
faulty
Fault code: 136
(Flashing code: 10)

N>

Remove fuel-injection pump and
renew quantity actuator.

Disconnect plug connection of fuel-
injection pump (top picture).

Attach test adapter KDEP 1165 with
adapter lead KDEP 1165/300 to
connecting lead to fuel-injection
pump (picture, bottom).

Connect multimeter with commercially
available test leads to following
measurement sockets:
socket 4 and ground
socket 7 and ground

Measure resistances.

Set value: > 1 M Ω

Are set values attained?

Y

V

Connect multimeter with commercially
available test leads to measurement
sockets 4 and 7 (picture, bottom).

N>

Remove fuel-injection pump and
renew quantity actuator.

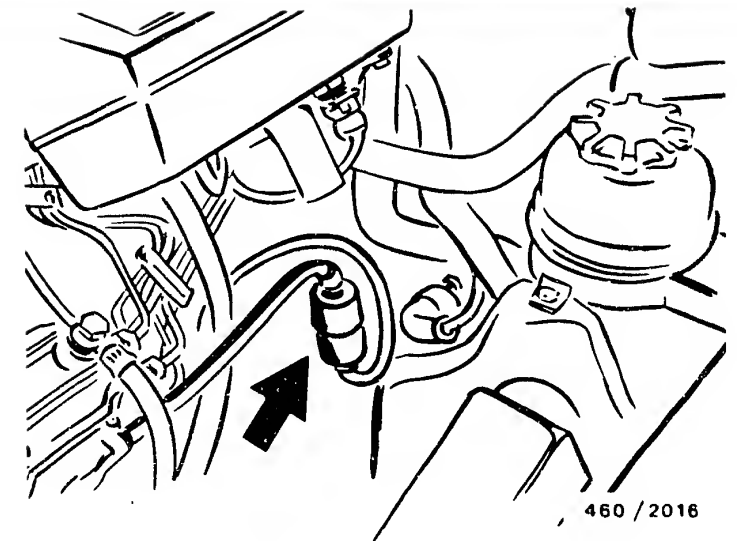
Measure resistance.

Set value: see brief instructions

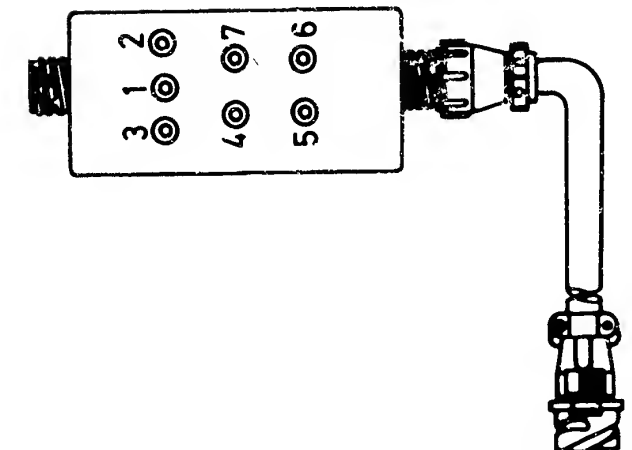
Set value attained?

V

Continued on next picture page



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SELF-DIAGNOSIS TEST PROGRAM (25) (CONTINUED 1)

Attach test adapter KDEP 1165 with adapter lead KDEP 1165/301 to plug, control unit (top picture).

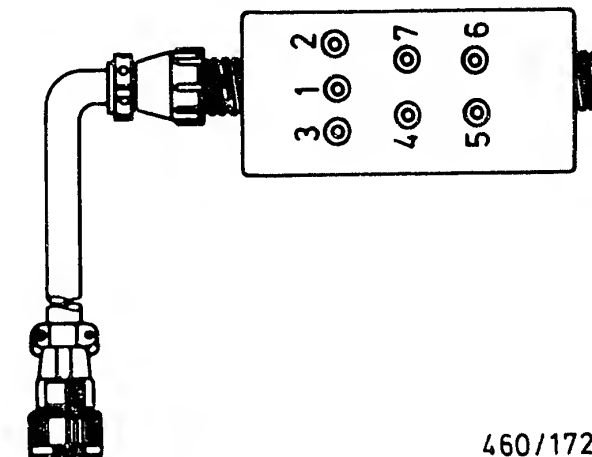
Jumper measurement sockets 4 and 7 at test adapter.
Detach connector at control unit 1 and check leads term. 1 and term. 21 to test adapter with test leads KDZS 0004 for open-circuit/contact resistance (bottom picture).

Set value: approx. 0 Ω

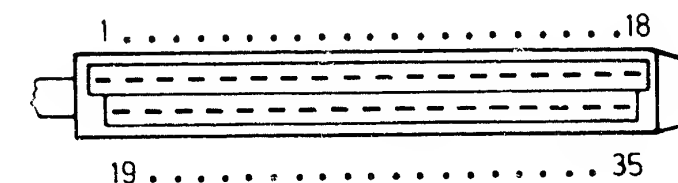
Set value attained?

N>

Eliminate open-circuit in lead/contact resistance; renew control unit 1 if applicable.



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460/1573

Return to self-diagnosis test table B17

E15

<=>

E16

<=>

SELF-DIAGNOSIS TEST PROGRAM (26)

Needle movement
sensor
Signal too high
Fault code: 142
(Flashing code: 11)

N>

Needle movement sensor defective,
renew complete fuel injector.

Disconnect plug connection (top
picture).

Check plug for corrosion and
loose contact.
It must not be possible to push
back contacts.
Connect multimeter with test leads
KDUM 0008 to plug, needle movement
sensor.
Measure resistance.
Set value: see brief instructions

Set value attained?

Y
V

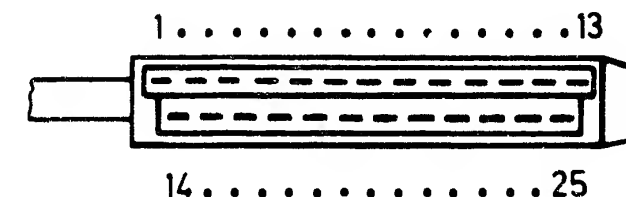
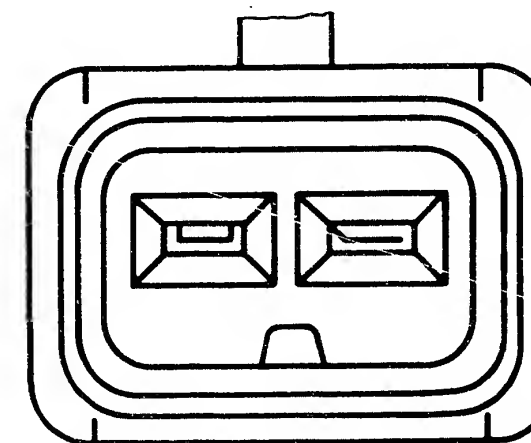
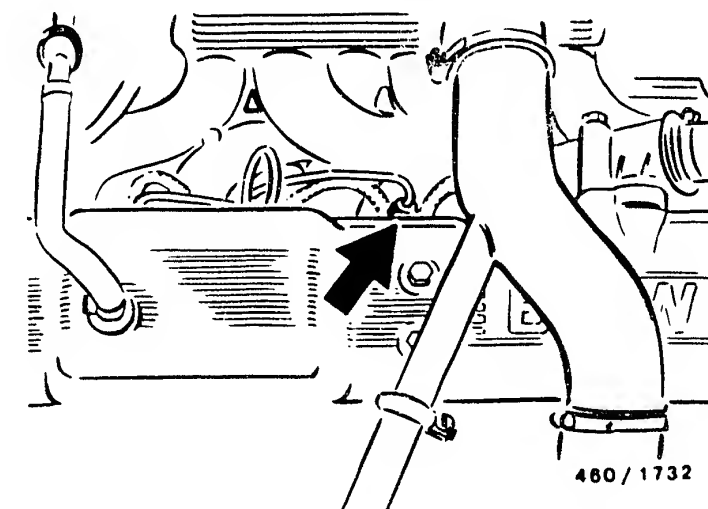
Detach plug, control unit 2.
Check leads for open-circuit:
from control unit 2 term. 3 and
term. 20 to plug, needle movement
sensor term. 2 and term. 1.
Check lead for short-circuit to
positive:
From control unit 2 term. 20 to
plug, needle movement sensor
term. 1.

N>

Repair leads; renew control unit 2
if applicable.

Y
V

Return to self-diagnosis
test table B17



SELF-DIAGNOSIS TEST PROGRAM (27)

Needle movement
sensor
Signal too low
Fault code: 142
(Flashing code: 11)

N>

Needle movement sensor defective,
renew complete fuel injector.

Disconnect plug connection (top
picture).

Connect multimeter with test leads
KDUM 0008 to plug, needle movement
sensor.

Measure resistance.

Set value: see brief instructions

Set value attained?

Y

V

Connect multimeter with test lead
KDUM 0008 to one terminal post of
plug, needle movement sensor and
with commercially available test
lead to ground.

N>

Needle movement sensor defective,
renew complete fuel injector.

Measure resistance.

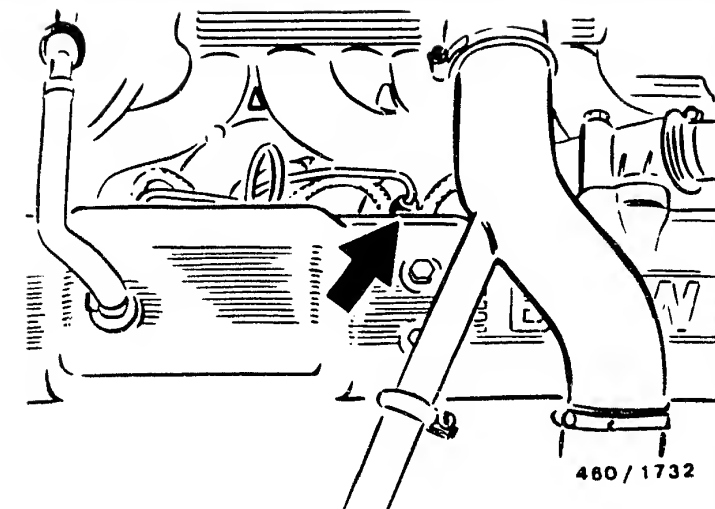
Set value > 1 M Ω

Set value attained?

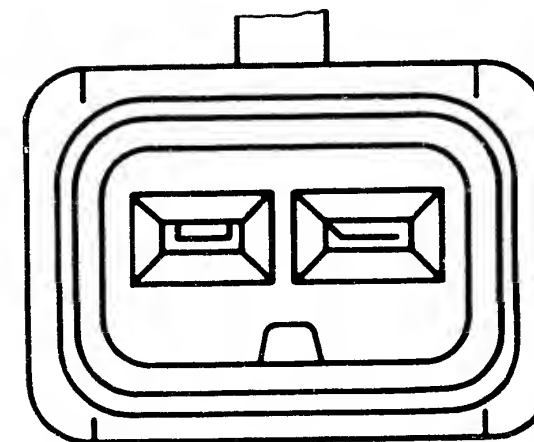
Y

V

Continued on next picture page



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SELF-DIAGNOSIS TEST PROGRAM (27) (CONTINUED 1)

Detach plug, control unit 2.

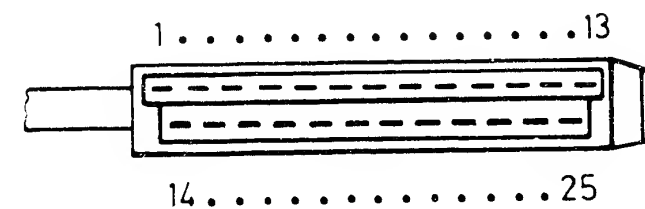
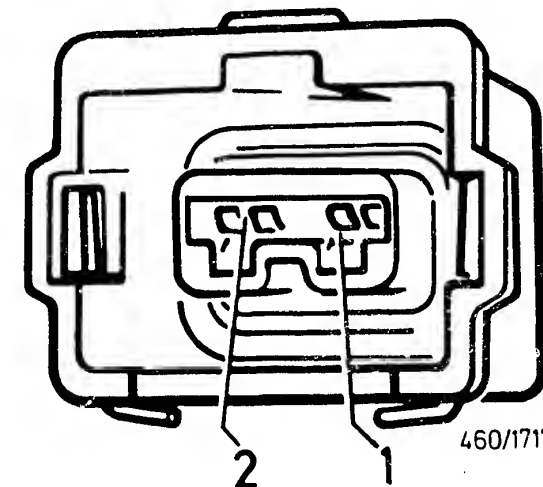
Check leads:

From control unit 2 term. 3 and term. 20 to plug, needle movement sensor term. 2 and term. 1 for short-circuit.

From control unit 2 term. 20 to plug, needle movement sensor term. 1 for short to ground.

N>

Repair leads; renew control unit 2 if applicable.



Return to self-diagnosis test table B17

E21

<=>

E22

<=>

SELF-DIAGNOSIS TEST PROGRAM (28)

Start of injection
Regulation
faulty
Fault code: 144
(Flashing code: 15)

N>

Remove fuel-injection pump.
Renew start-of-injection solenoid
valve.

Disconnect plug connection.

Connect multimeter with test lead
KDUM 0008 to one terminal post of
plug, solenoid valve and with
commercially available test lead
to ground.

Measure resistance.

Set value: > 1 M Ω

Set value attained?

Y

V

Connect multimeter with test leads
KDUM 0008 to solenoid valve.

N>

Remove fuel-injection pump.
Renew start-of-injection solenoid
valve.

Measure resistance.

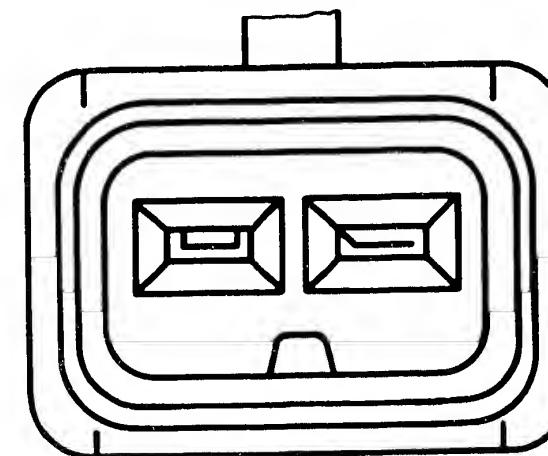
Set value: see brief instructions

Set value attained?

Y

V

Continued on next picture page



460/1733

SELF-DIAGNOSIS TEST PROGRAM (28) (CONTINUED 1)

Check plug for corrosion and loose contact.
It must not be possible to push back contacts.

Check leads:

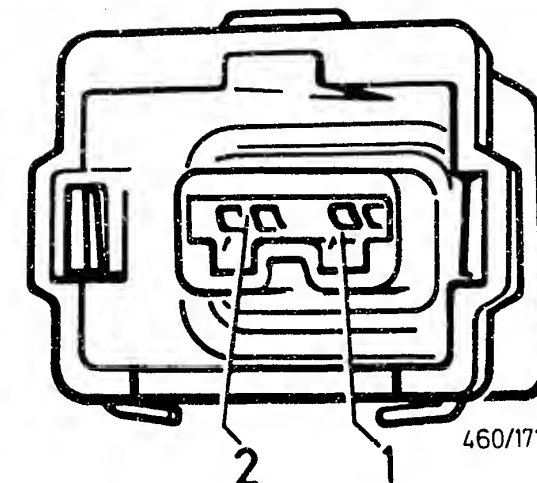
From plug, control unit 2 term. 1 and term. 2 to solenoid valve term. 1 and term. 2 for open-circuit.

Use multimeter with test leads KDZS 0004 and KDUM 0008.

Leads O.K.?

N>

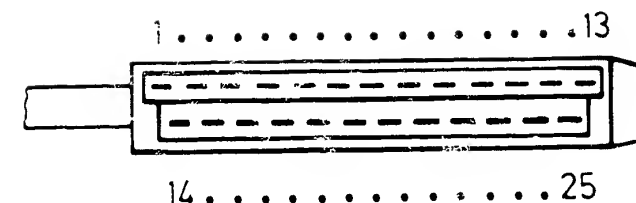
Repair defective leads/plugs;
renew control unit 2 if applicable.



Remove fuel-injection pump.
Check supply-pump pressure and timing-device profile.

N>

Adjust supply-pump pressure and test timing-device profile.
If necessary, repair or renew fuel-injection pump.



Return to self-diagnosis test table B18

SELF-DIAGNOSIS TEST PROGRAM (29)

Interface
Speed signal
faulty
Fault code: 145

N>

Repair defective leads/plugs;
renew control unit 2 if applicable.

Detach plug, control unit 1 and 2
(top picture).

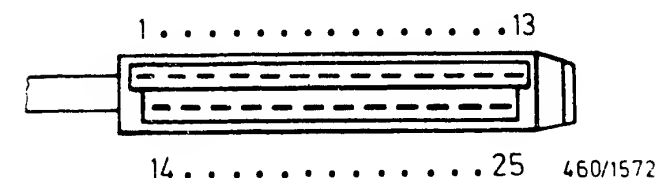
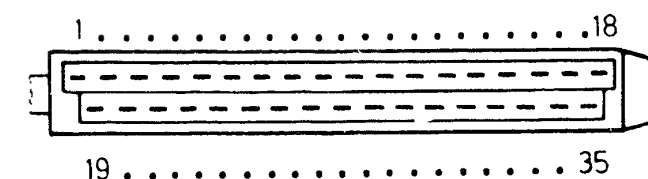
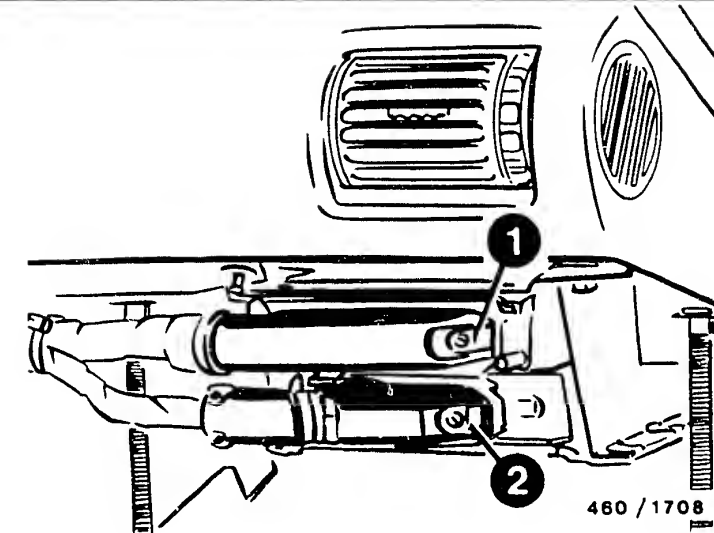
Check plug for corrosion and
loose contact.
It must not be possible to push
back contacts.

Check lead:
from plug, control unit 1
term. 8 to
plug, control unit 2 term. 6
for open-circuit.

Use multimeter with test leads
KDZS 0004.

Set value: approx. 0 Ω

If set value attained, establish
defective control unit by way of
replacement.



Return to self-diagnosis
test table B18

SELF-DIAGNOSIS TEST PROGRAM (30)

Brake/
brake safety switch
Comparison not O.K.
Fault code: 146

N>

Renew switch.

Detach plug (top picture).

Connect 1 multimeter in each case
to one circuit.

Actuate brake pedal several times.

Measure resistance.

Does the reading of both multi-
meters change simultaneously
from infinity Ω to 0 Ω ?

Connect multimeter to plug,
voltage supply, brake/brake safety
switch and ground.

N>

Switch off ignition.
Repair lead.

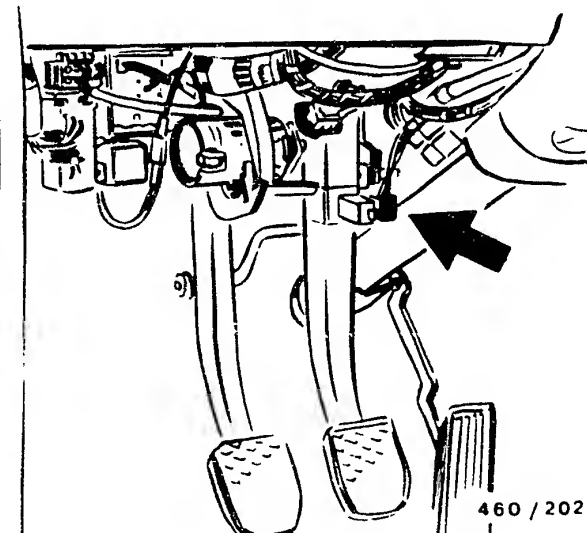
Switch on ignition.

Measure voltage.

Set value: 11.5...14.5 V

Set value attained?

Continued on next picture page



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SELF-DIAGNOSIS TEST PROGRAM (30) (CONTINUED 1)

Switch off ignition.

Check plug for corrosion and loose contact.

It must not be possible to push back contacts.

Check leads:

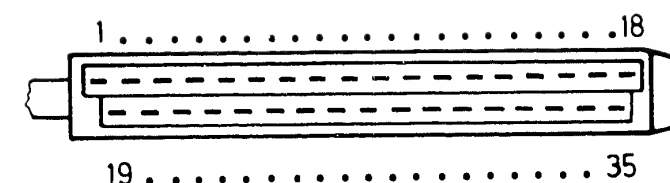
from plug, brake/brake safety switch to plug, control unit 1 term. 11 and term. 5 for open-circuit.

Use multimeter with commercially available test lead and test lead KDZS 0004.

Set value: approx. 0 Ω

Set value attained?

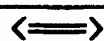
Repair defective lead/plugs;
renew control unit 1 if necessary.



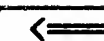
460/1573

Return to self-diagnosis
test table B18

F03



F04



TROUBLE-SHOOTING PROGRAM (1)

Component/function:

Voltage supply -
control units

Test reversed-polarity protection
relay.

Connect multimeter with commercially
available test leads and test prods
to output of reversed-polarity
protection relay (term. 87).

Switch on ignition.

Set value: 11.5...14.5 V

Set value attained?

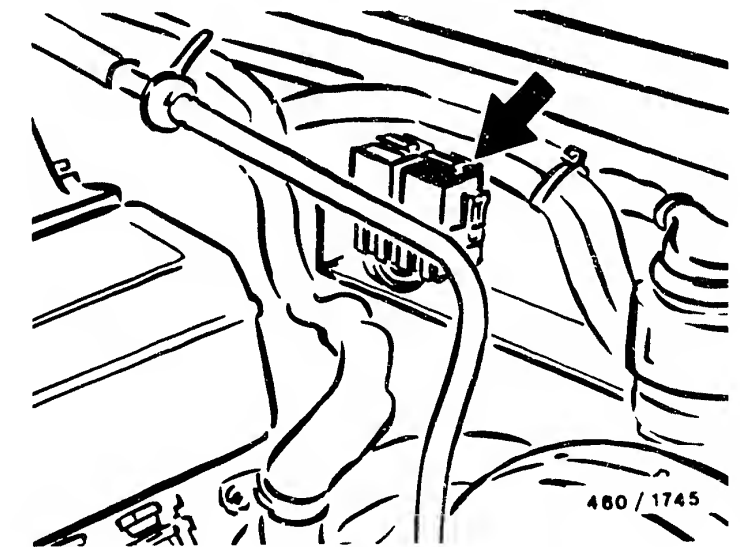
N>

Test function and actuation of
reversed-polarity protection relay:

15 to term. 86 b
30 to term. 30
31 to term. 85
30 to term. 87

Eliminate any open-circuit in lead.

If, given correct actuation, there
is no voltage at term. 87, renew
reversed-polarity protection relay.



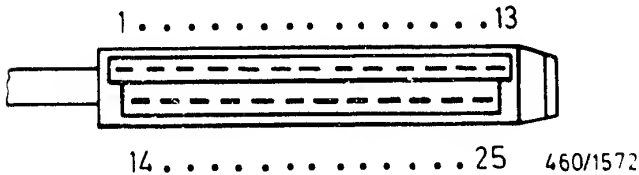
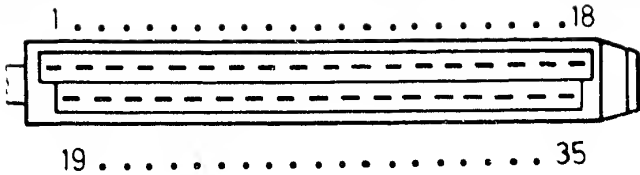
Continued on next picture page

TROUBLE-SHOOTING PROGRAM (1) CONTINUED (1)

Test voltage supply – control units
Switch off ignition.
Detach connectors at control unit 1 and 2 (picture).
Connect voltmeter with test leads KDZS 0004 to terminals listed below.
Control unit 1
term. 2 (+) and 19 (–)
term. 3 (+) and 20 (–)
Control unit 2
term. 5 (+) and 14 (–)
term. 19 (+) and 15 (–)
Switch on ignition.
Set value: 11.5...14.5 V
Set value attained?

N>

Test appropriate line path for open circuit.
Eliminate open circuit.



Return to trouble-shooting chart B06

TROUBLE-SHOOTING PROGRAM (2)

Component/function:
Coupling switch

N>

Detach control-unit plug at control unit 1 (picture).
Connect multimeter with test leads KDZS 0004 to term. 35 and term. 27.
Actuate clutch pedal.

Does reading change from approx. 0 Ω to > 1 M Ω ?

Reading: approx. 0 Ω
-Switch defective, replace.

Reading: >1M Ω

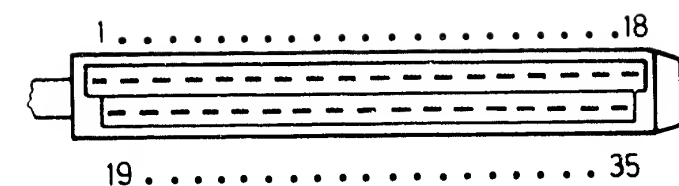
-Test installation position of switch

-Switch defective, replace

-Eliminate open circuit in lead:

a. Term. 35 of control-unit plug to clutch switch

b. Term. 27 of control-unit plug to clutch switch



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Return to trouble-shooting chart
B06

F09

<=>

F10

<=>

TROUBLE-SHOOTING PROGRAM (3)

Component/function:
A/C switch

Test voltage signal at control unit 1

Detach connector at control unit 1.

Connect voltmeter with test leads KDZS 0004 to connector term. 16 (+) and ground.

Switch on ignition and air conditioning.

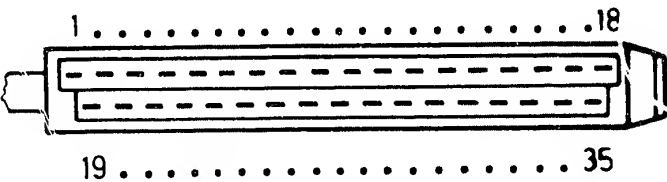
Set value: 11.5...14.5 V

If set value attained, renew control unit 1.

N>

No voltage at term. 16,
test lead for open circuit.

Eliminate open circuit.



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Return to trouble-shooting chart
B06

TROUBLE-SHOOTING PROGRAM (4)

Component/transmission indicator

Detach plug (picture, arrow; switch attached in concealed position).

Connect multimeter.

Actuate switch.

Measure resistance.

Does reading change from infinity Ω to 0 Ω ?

N>

Renew switch.

Check plug for corrosion and loose contact.

Check leads::

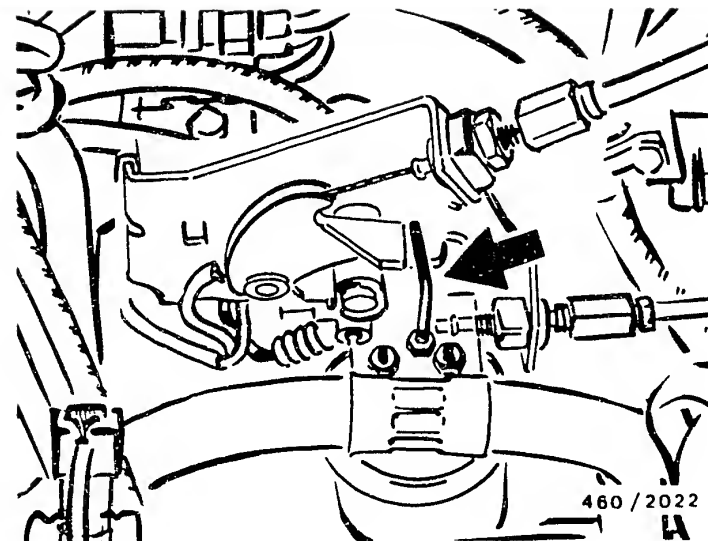
From control unit 1 term. 22 and term. 35 to transmission indicator for open-circuit.

Set values attained?

N>

Repair leads/plugs; renew control unit 1 if applicable.

Continued on next picture page



TROUBLE-SHOOTING PROGRAM (4) CONTINUED (1)

Connect multimeter to transmission indicator.

Detach hose at pneumatics actuator.

Connect Mityvac pump and apply vacuum.

Measure resistance.

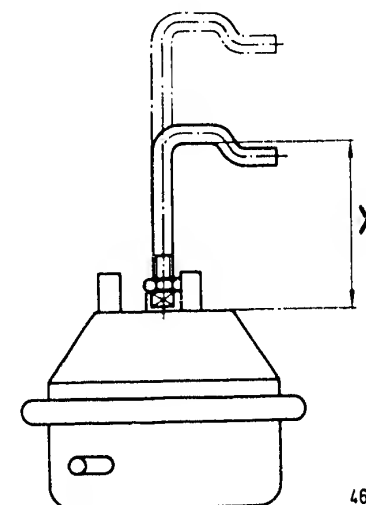
Does reading on multimeter change from infinity Ω to 0 Ω ?

N>

Check and if necessary correct setting dimension of control unit bow.

See brief instructions for dimension X.

To check, remove control unit and note position of bow (bottom picture).



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Check hose connections.

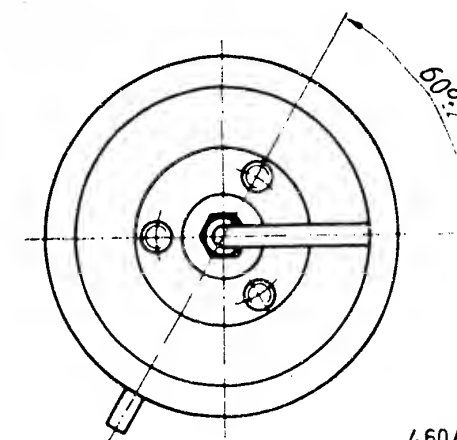
Check vacuum supply.

Set value: see brief instructions

Set value attained?

N>

Renew hose connections and vacuum pump if applicable.



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Continued on next picture page

TROUBLE-SHOOTING PROGRAM (4) CONTINUED (2)

Detach connector at switching
valve (FGR)
(picture, arrow).

N>

Renew switching valve.

Connect multimeter with commercially
available test leads and test prods
to switching valve.

Measure resistance.

Set value: see brief instructions

Set value attained?

Y

Connect multimeter with commercially
available test leads to connector.

N>

Eliminate open-circuit in lead;
renew control unit 2 if necessary.

Measure voltage.

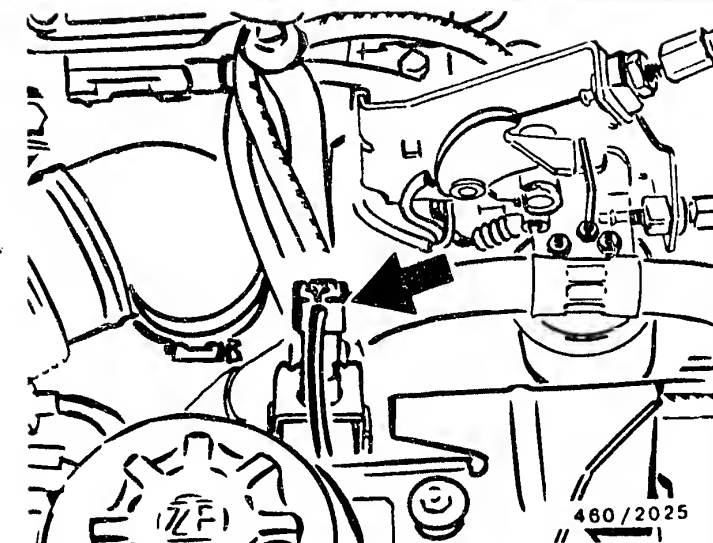
Switch on ignition.

Set value: approx. 12 V

Set value attained?

Y

Return to trouble-shooting chart
B06



TROUBLE-SHOOTING PROGRAM (5)

Component/transmission neutral switch

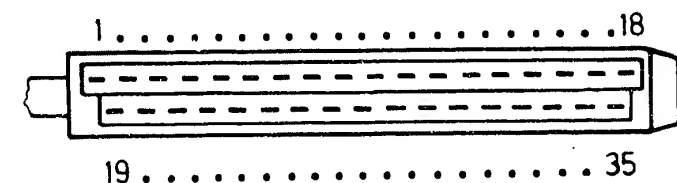
N>

Detach connector, control unit 1.
Connect test leads KDZS 0004 to multimeter.
Perform measurement between term. 27 and term. 35.

"Neutral" position of transmission selector switch:
Set value: 0 Ω
Position "driving position X" of transmission selector switch:
Set value: infinity Ω

If set values are attained, renew control unit 1.

Check and if necessary renew transmission neutral switch.
Eliminate open-circuit in lead.



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Return to trouble-shooting chart
B06

F19

<=>

F20

<=>

TROUBLE-SHOOTING PROGRAM (6)

Component
Water level sensor

Test prerequisites: diagnosis-lamp
test O.K.

Disconnect plug connection.
Jumper connection sockets.

Switch on ignition.

Does warning lamp light up?

Switch off ignition.
Check leads.

Connect multimeter with test leads
KDUM 0008 to connector.

Measure voltage.

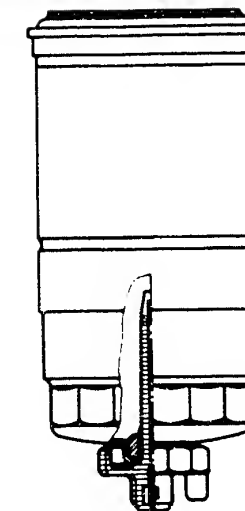
Switch on ignition.

Set value: >10 V

Is set value attained?

Check fuse F 17.

Continued on next picture page



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TROUBLE-SHOOTING PROGRAM (6) CONTINUED (1)

Remove water level sensor; catch
fuel when doing so.

Attach connector.

Immerse sensor in a metal vessel
full of water.

Connect metal vessel to vehicle
ground.

Switch on ignition.

Does warning lamp light up?

N>

Renew water level sensor.

Return to trouble-shooting chart
B06

TROUBLE-SHOOTING PROGRAM (7)

Component/function
Exhaust gas recirculation

Check internal resistance of
electropneumatic switching
valve

Test prerequisites:

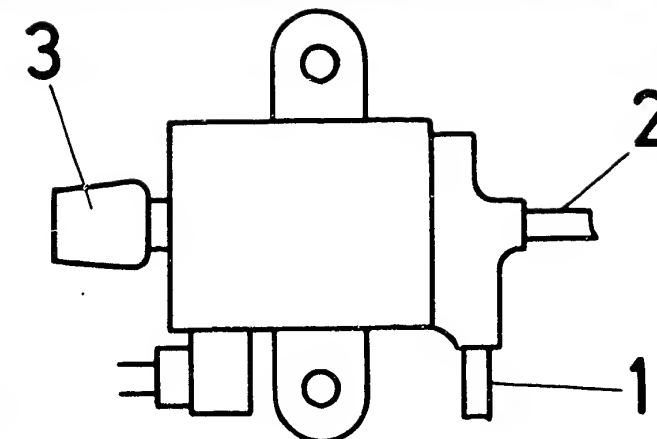
- engine at operating temperature
(approx. 80° C)
- cold EGR pipe

Detach plug connection.
Connect multimeter with
commercially available test leads
to terminal posts of switching
valve.

Set value: see brief instructions

Is set value attained?

Switch-over valve defective,
replace.



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- 1 = Connection, EGR valve
- 2 = Connection, vacuum pump
- 3 = Atmospheric ventilation

Continued on next picture page



Lead connection between control unit
and component

N>

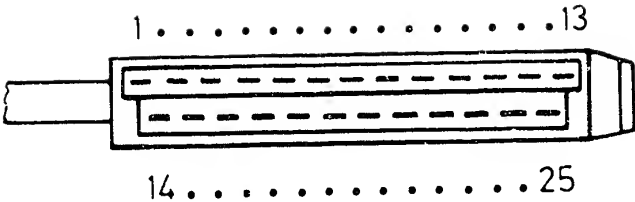
Eliminate open circuit in
lead.

Detach connector at control unit 2
(top picture) and check leads
term. 7 and term. 1 to connector,
switching valve with test leads
KDZS 0004 for open-circuit.

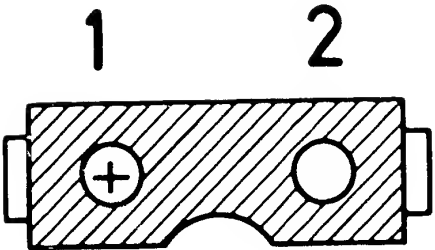
Jumper leads at connector (bottom
picture).

Set value: 0 Ω

Is set value attained?



460/1575



460/1729

Test voltage supply

Test prerequisites:

- engine at operating temperature (approx. 80° C)
- cold EGR pipe
- engine idling

Attach connector to control unit 2.

Connect multimeter with commercially available test leads and test prods to connector term. 1 (+) and term. 2(-).

Important:

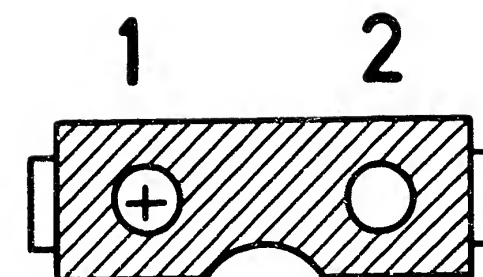
The terminals must have the above-mentioned polarity, in order to guarantee proper functioning of the switching valve (top picture).

Set value: approx. 12 V

Is set value attained?

N>

Renew control unit 2.



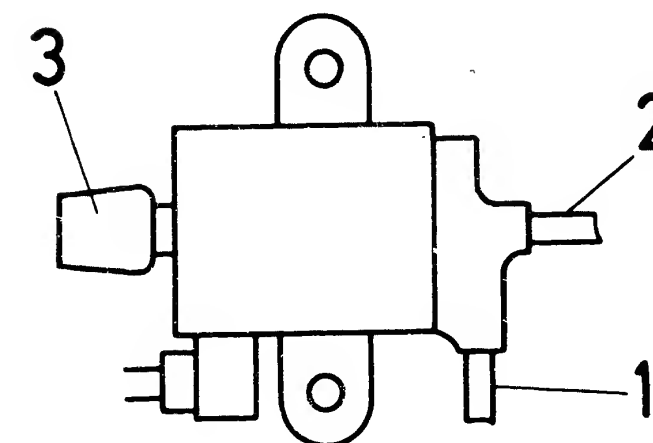
460/1729

Test vacuum supply

- are the hose connections O.K.?
- correct terminal assignment? (bottom picture)

N>

- Replace hoses
- Vacuum pump defective, replace.



- 1 = Connection, EGR valve
- 2 = Connection, vacuum pump
- 3 = Atmospheric ventilation

460/1738

Continued on next picture page

EGR valve
(functional test)

N>

EGR valve defective, replace.

Test prerequisites:

-engine at operating temperature
(approx. 80° C)

Detach vacuum hose (1).

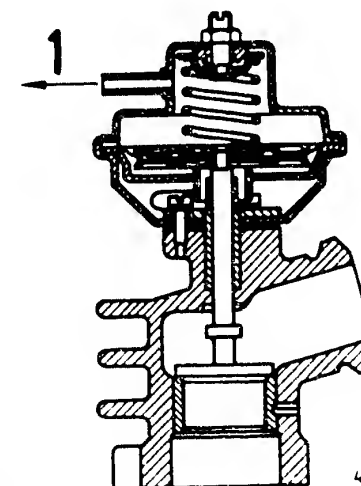
Connect Mityvac pump.

Generate approx. 350 mbar negative
pressure.

Vent Mityvac pump.

It must be possible to perceive
a clearly audible clicking sound.

Repeat test sequence several
times.



460/1539

Return to trouble-shooting chart
B06

TROUBLE-SHOOTING PROGRAM (8)

Component/Function:

Preheating system

Note:

If the start of delivery is set correctly, this may considerably reduce the service life of the sheathed-element glow plug.

Test requirements:

- battery O.K.
- engine compression O.K., test pressure drop if necessary
- fuel system/injection system O.K.

Test voltage supply of sheathed-element glow plugs.

Connect voltmeter at sheathed-element glow plugs one after the other to ground.

Position glow-plug and starter switch to position 1 (red indicator lamp lights), preheating is initiated.

Voltmeter must indicate >10 V.

Attention:

The system switches off automatically after 8...13 seconds. If the measurement must be repeated, the glow-plug and starter switch must first be positioned again to position 1. Minimum voltage present at all sheathed-element glow plugs?

N>

Test leads from glow-duration control unit term. 1...6 to the sheathed-element glow plugs for open circuit.

If necessary, eliminate open circuit.

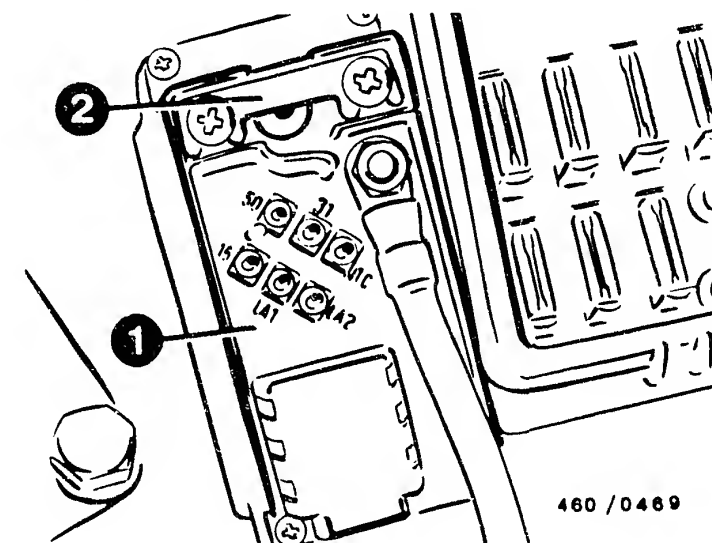
Test lead from battery (+) to glow-duration control unit for open circuit.

If necessary, eliminate open circuit.

Test ground cable from glow-duration control unit term. 1 for open circuit. If necessary, eliminate open circuit.

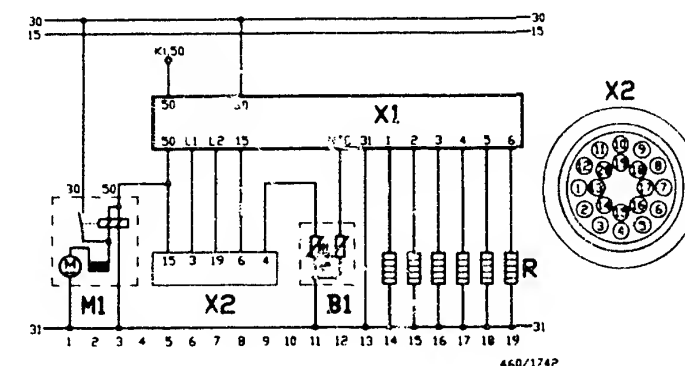
Remove protective cap from glow-duration control unit and check strip-shaped fuse (80A), replace if necessary.

If points 1...4 O.K., then replace glow-duration control unit.



- 1 = Glow-duration control unit
- 2 = Strip-shaped fuse (80 A)

Terminal diagram, preheating system



Continued on next picture page

TROUBLE-SHOOTING PROGRAM (8) CONTINUED (1)

Test starting indicator lamps
(upper illustration)

Position glow-plug and starter
switch to position 1.
Starting indicator lamp L1 (red)
must light up.
Shortly afterwards, L1 (red)
goes out and L2 (green) must
light up.

Do both starting indicator
lamps light up in the correct
sequence?

N>

Green indicator lamp L2 does not
light (center illustration)

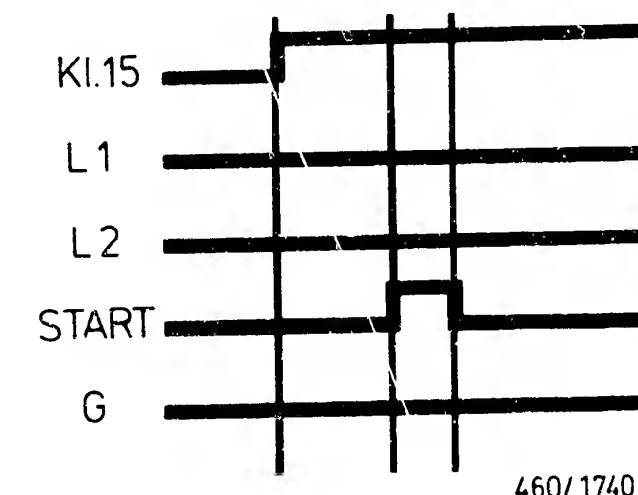
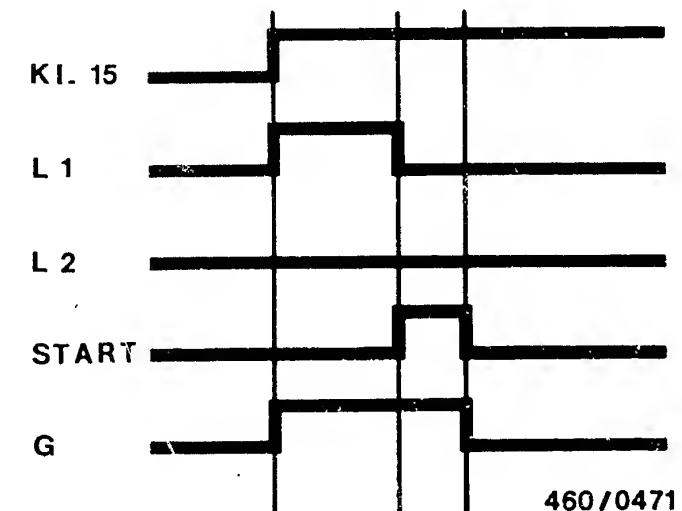
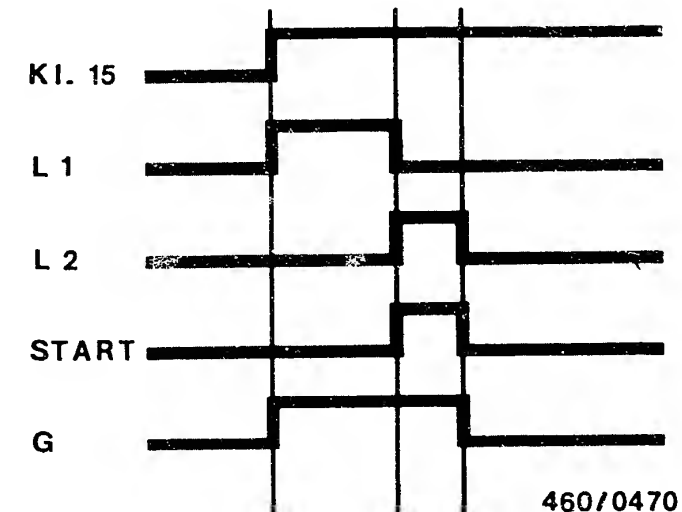
Test sheathed-element glow
plugs (G) for open circuit.
Replace defective sheathed-
element glow plug(s).

Both indicator lamps do not
light (lower illustration)

1. Test leads from glow-duration
control unit to the start-
ing indicator lamps L1 and
L2, including the starting
indicator lamps and their
ground, for open circuit.

2. Remove protective cap from
glow-duration control unit
and check strip-shaped
fuse (80A), replace if
necessary.

If points 1 and 2 O.K., replace
glow-duration control unit.



Continued on next picture page

Continued on next picture page

Red indicator lamp L1 flashes
(upper illustration)

One flashing indicator lamp indicates that the sheathed-element glow plugs continue to glow after starting. Replace glow-duration control unit.

Remark:

If the red indicator lamp L1 does not light up, however, readiness for starting (green lamp L2) is indicated after preheating, the red lamp may be defective as well.

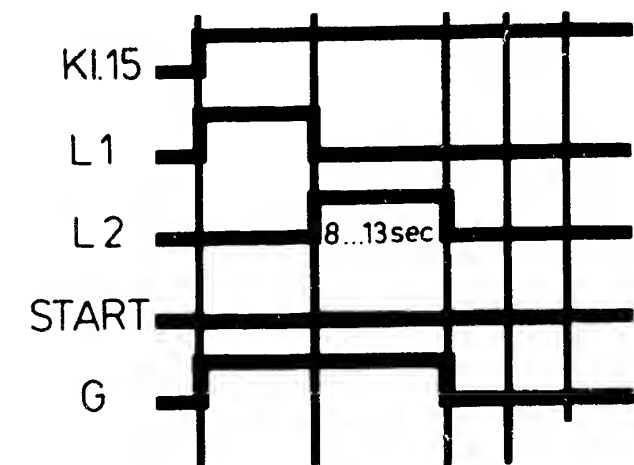
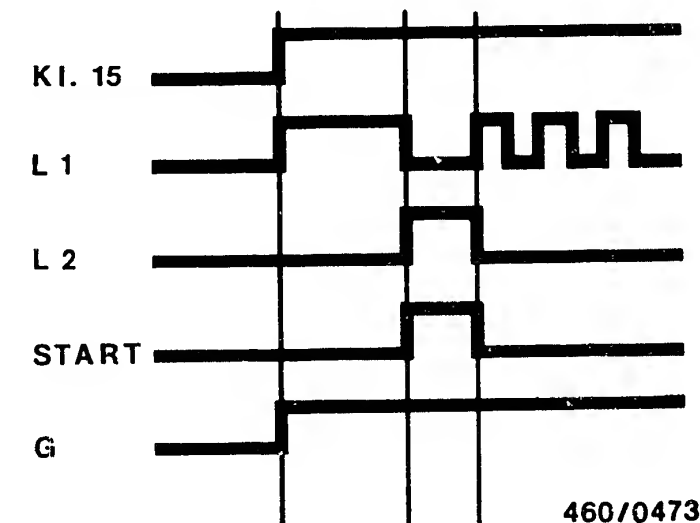
Testing safety cutoff

Connect voltmeter at one sheathed-element glow plug to ground. Position glow-plug and starter switch to position 1 (red indicator lamp lights). Preheating is initiated. After a certain duration of preheating, dependent upon the ambient temperature, L2 (green) lights up. Voltmeter must indicate voltage for 13 seconds (lower illustration). After completion of the specified time, the voltmeter must indicate 0 V.

Voltmeter indicating 0 V after the specified time?

Replace glow-duration control unit.

Continued on next picture page



TROUBLE-SHOOTING PROGRAM (8) CONTINUED (3)

Testing glowing on actuation of starting motor

Connect voltmeter at one sheathed-element glow plug to ground.
Position glow-plug and starter switch to position 2 (starting).
Voltmeter must indicate a voltage of 10 V.

Is voltage present?

N>

1. Test lead from glow-plug and starter switch term. 50 to glow-duration control unit term. 50 for open circuit.

Eliminate open circuit.

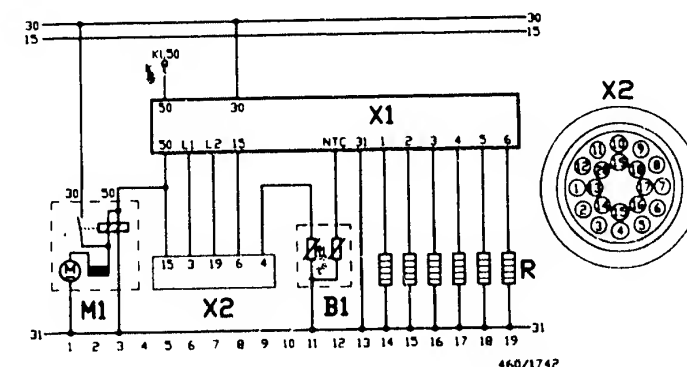
2. If point 1 O.K., replace glow-duration control unit.

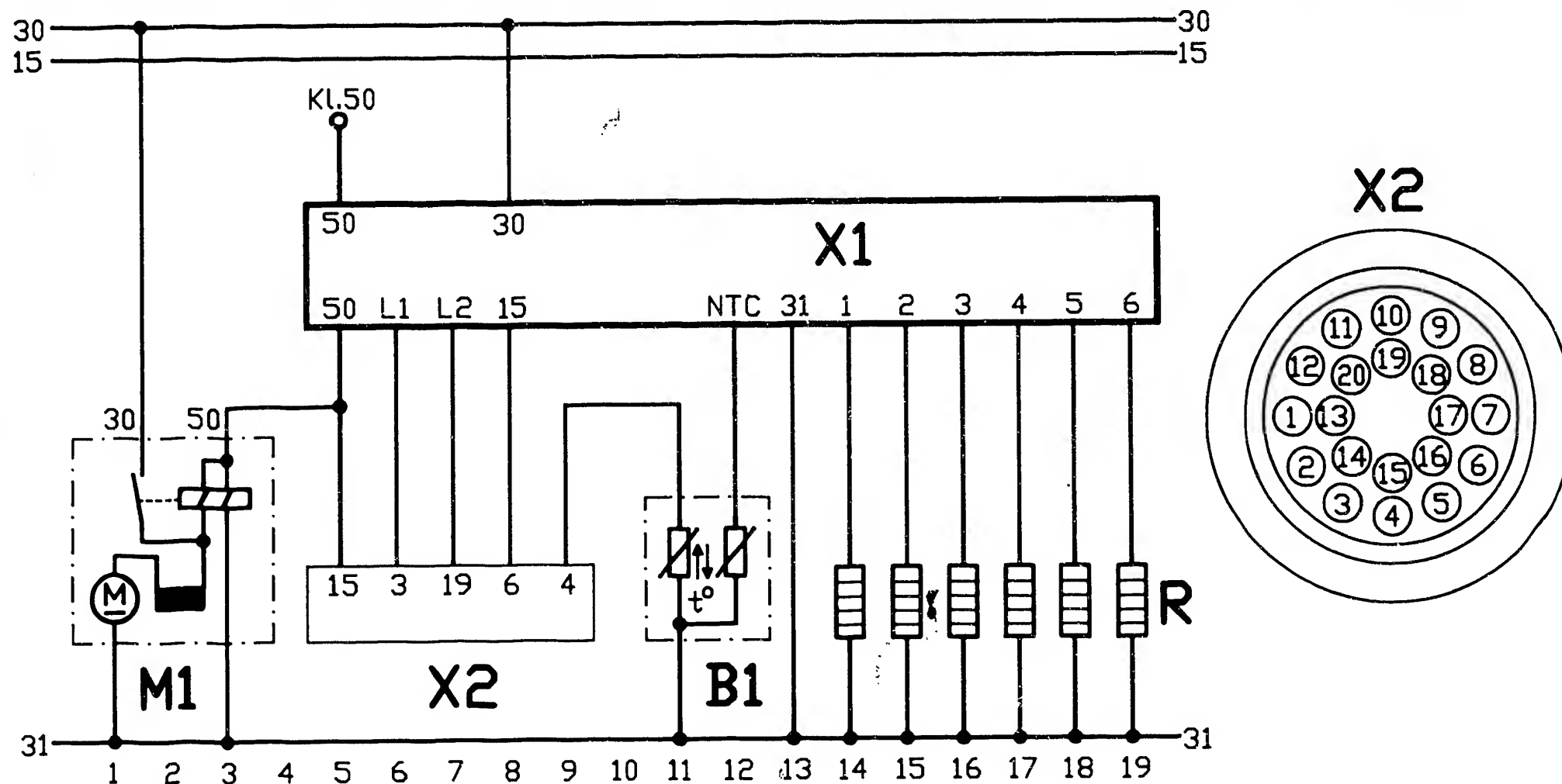
Testing sheathed-element glow plugs.
Test sheathed-element glow plugs individually for continuity using ohmmeter.
Do the sheathed-element glow plugs have continuity?

N>

Replace sheathed-element glow plug(s).

Return to trouble-shooting chart B06





B1 = Temperature sensor
M1 = Starting motor
R = Sheathed-element glow plugs

X1 = Glow-duration control unit
X2 = Engine plug

TROUBLE-SHOOTING PROGRAM (9)

Component/Function:

Fuel heater

Test 1: Temperature switch,
voltage supply
(upper illustration,
arrow)

Disconnect cable connector.
Connect multimeter with
commercially available test
leads to term. 1 and ground.

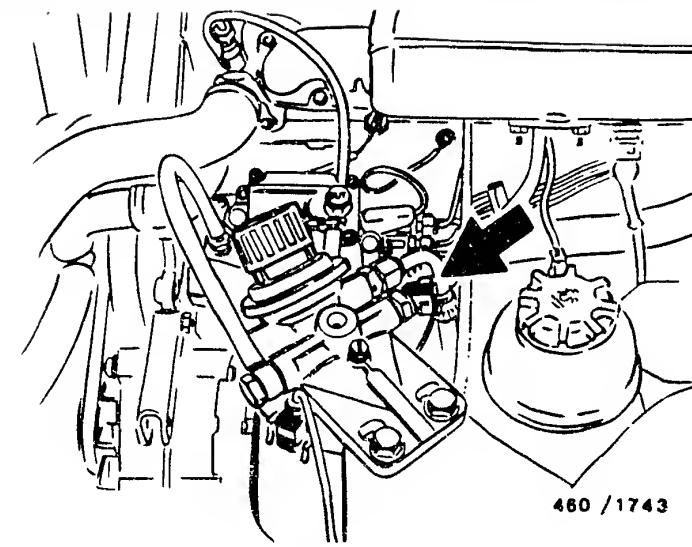
Switch on ignition.

Set value: approx. 12 V

Is set value obtained?

N>

Switch off ignition.
Eliminate open circuit in lead
between term. 6 of engine plug
and temperature switch (lower
illustration).



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Test 2: Operational test

Switch off ignition.
Connect multimeter with
test leads KDUM 0007 to
temperature switch.

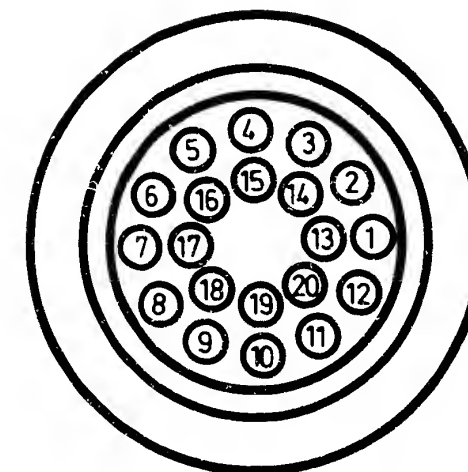
Switching point: approx. 5.5° C.

Set values: <5.5° C approx. 0 Ω
>15° C > 1M Ω

Is set value obtained?

N>

Temperature switch defective,
replace.



460 / 1744

Continued on next picture page

G15

<=>

G16

<=>

TROUBLE-SHOOTING PROGRAM (9) CONTINUED (1)

Test 3: Fuel-heater relay,
voltage supply

N>

Eliminate open circuit in lead
to term. 30.

Connect fuel-heater relay
(upper illustration, arrow).
Connect multimeter to socket 6
(30) and ground with commer-
cially available test
leads
(lower illustration).

Set value: approx. 12 V

Is set value obtained?

Test 4: Fuel-heater relay,
function

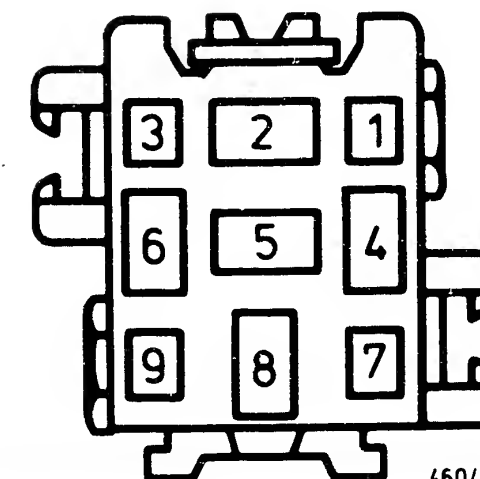
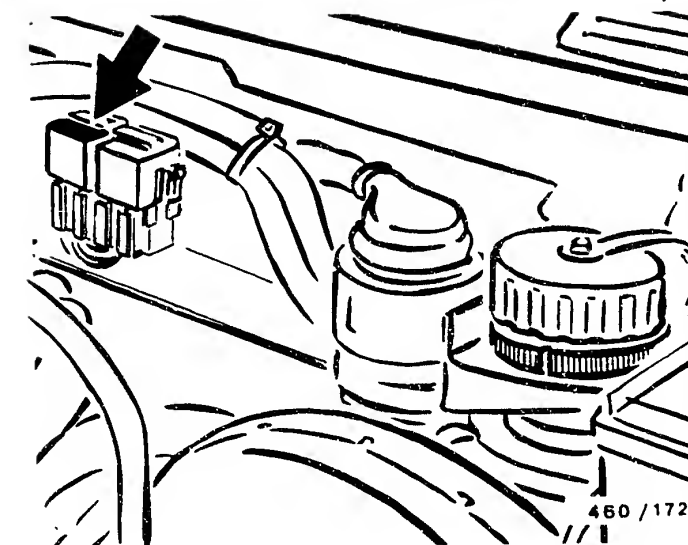
N>

Fuel-heater relay defective,
replace.

Check relay in disassembled
state for proper functioning.

Function O.K.?

Continued on next picture page



TROUBLE-SHOOTING PROGRAM (9) CONTINUED (2)

Test 5: Cable connection of
fuel-heater relay to
heating element
(upper illustration,
arrow)

N>

Eliminate open circuit in
lead.

Connect multimeter with
commercially available test
leads to socket 2 and term. 2
(center illustration).

Set value: approx. 0 Ω

Is set value obtained?

Y

Test 6: Heating element

N>

Heating element defective, replace.

Connect multimeter with
commercially available test
leads into lead term. 1 (+)
to ground (center illustration).

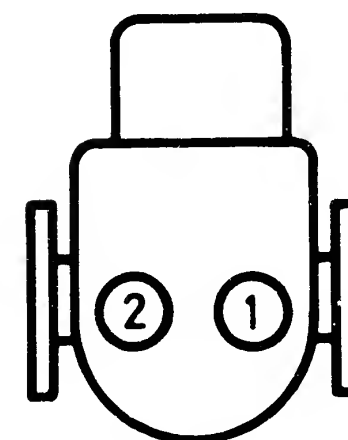
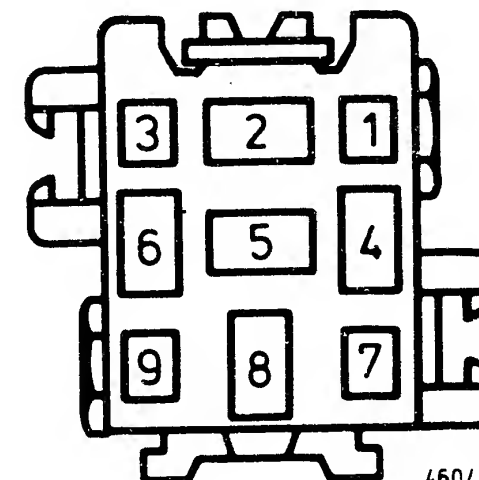
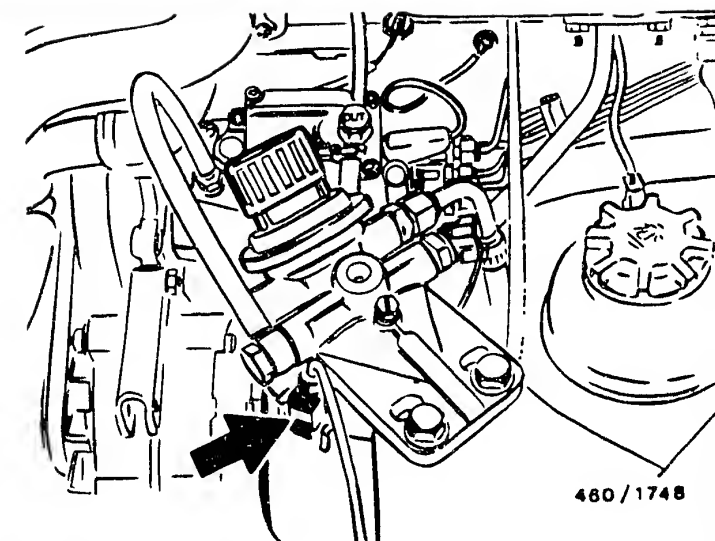
Switch on ignition.

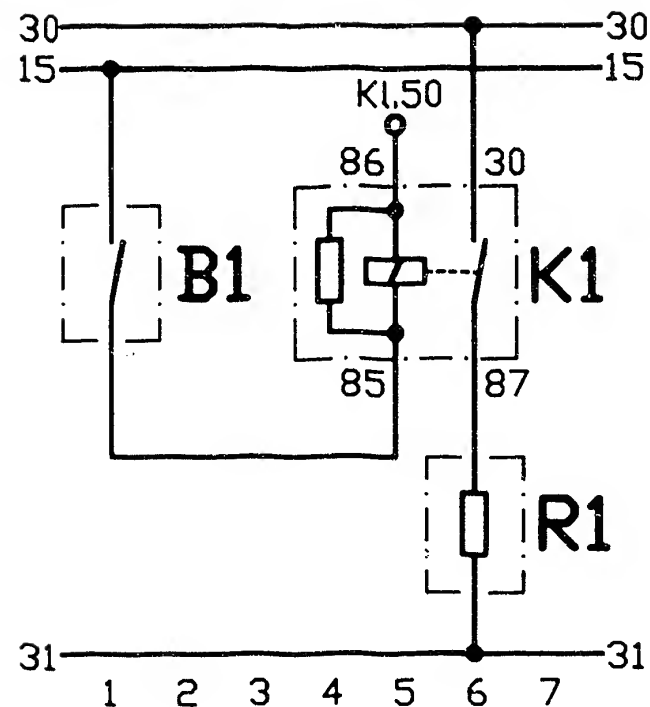
Set value: 3.5...8.5 A

Is set value obtained?

Y

Return to trouble-shooting chart
B06





460/1749

B1 = Temperature switch 5.5° C
 K1 = Fuel-heater relay
 R1 = Heating element

For production reasons:
 continued on the following
 coordinate.

TROUBLE-SHOOTING PROGRAM (10)

V

Component/function

Electric shut-off device (ELAB)

Connect test adapter KDEP 1165 with adapter leads KDEP 1165/300 and -/301 to plug connection, fuel-injection pump.

Connect multimeter to ELAB and ground.

Switch on ignition.

Connect sockets 1 and 2 of test adapter KDEP 1165 to commercially available test lead.

Measure voltage.

Is there a voltage step change from approx. 12 V to 0 V?

Note: Diagnosis lamp lights up continuously until the lead connection at the test adapter KDEP 1165 socket 1 and 2 is interrupted.

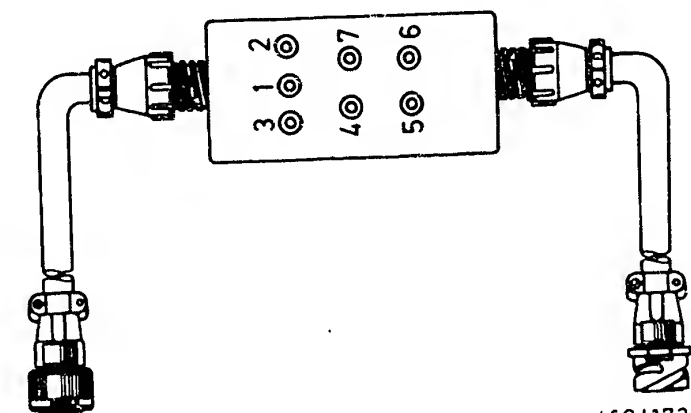
Y

V

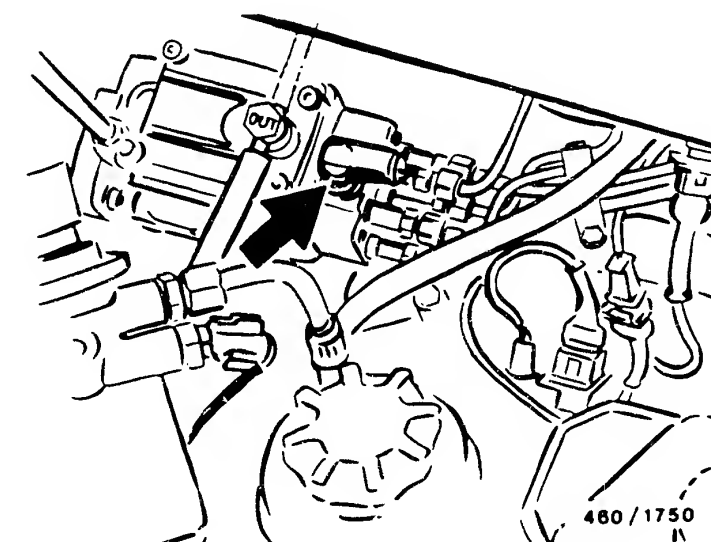
Continued on next picture page

N>

Renew control unit 1.



460/1735

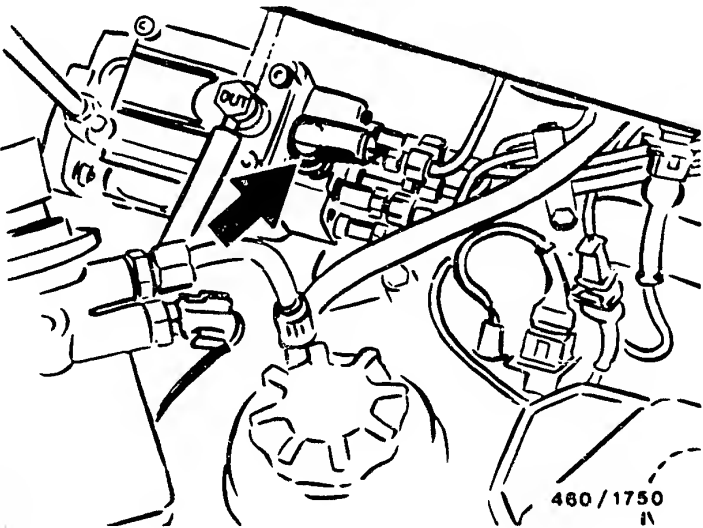


460/1750

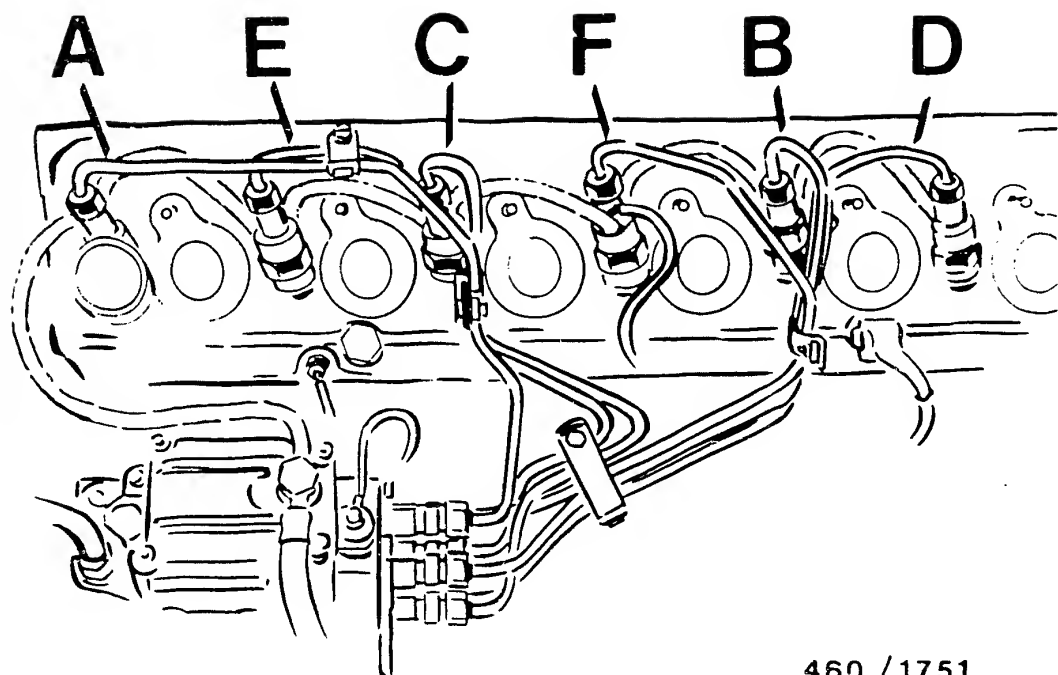
Start engine and allow it to idle.
Detach lead at ELAB.
Is engine switched off?
Clear fault memory!!

N>

Renew ELAB.



Return to trouble-shooting chart B06



460 / 1751

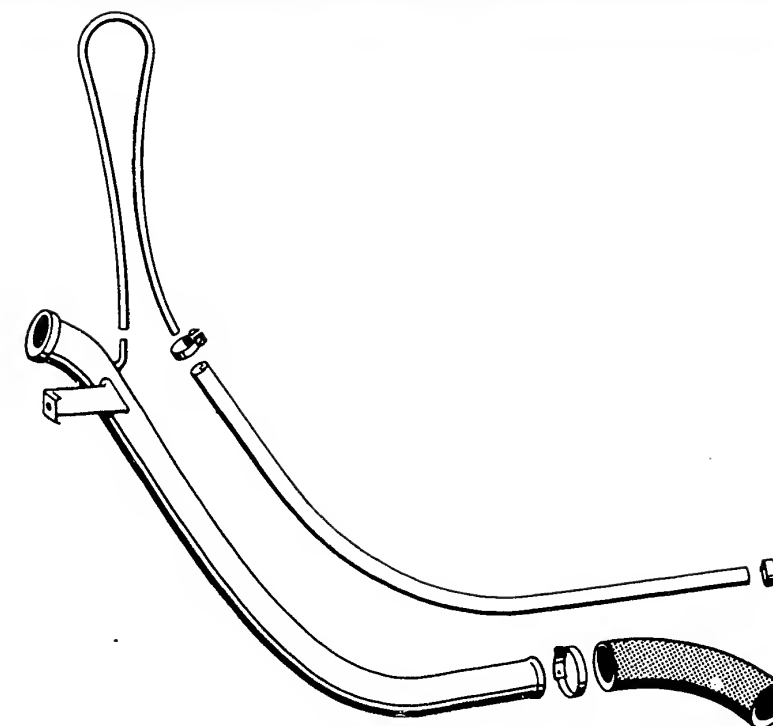
CHECKING THE ROUTING OF THE FUEL-INJECTION TUBING

The fuel-injection tubes are joined together by clamps, so that it is impossible to mix up the outlets.

Nevertheless, if anything is not clear, check the routing of the tubes in accordance with the illustration above.

The individual cylinders of the engine to which the injection-pump outlets are assigned are identified by the letters A to F.

Return to trouble-shooting chart.



460/0511

CHECKING THE TANK VENTILATION

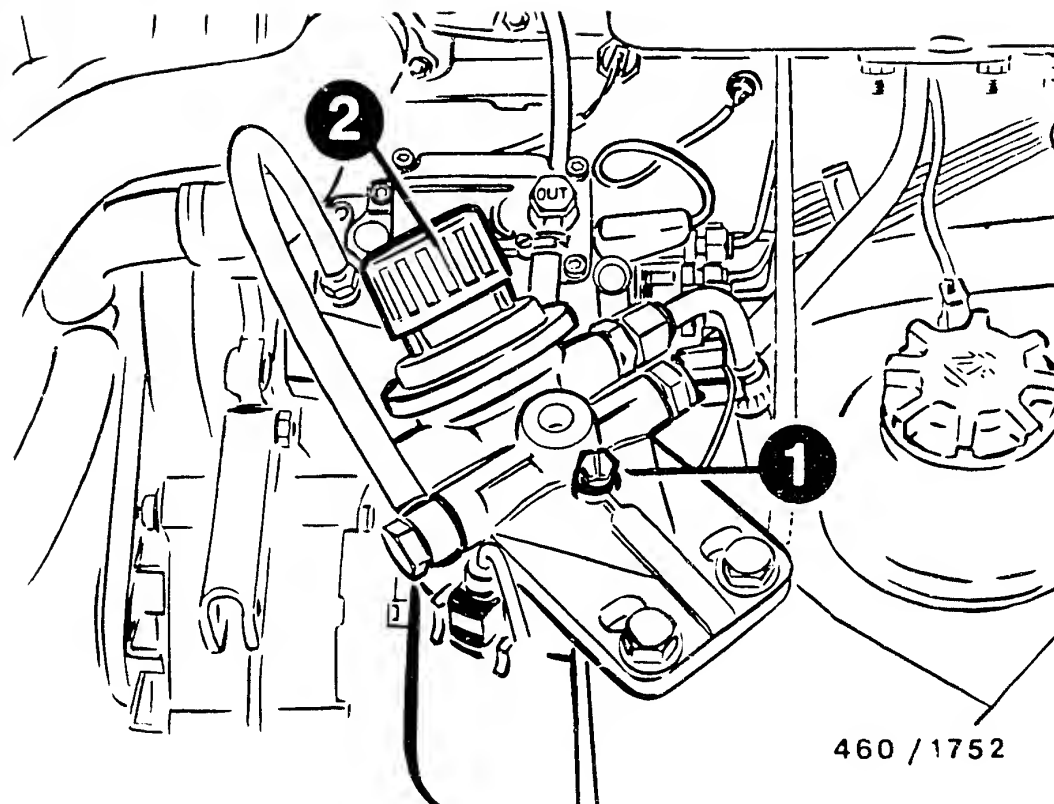
Open the tank filler cap.

If the fault no longer occurs after opening the tank filler cap, the tank ventilation is defective.

Remove the hose lines of the tank ventilation (illustration) and check for clogging or constrictions.

If necessary, check the fitting at the tank.

Return to trouble-shooting chart.



- 1 = Bleeder screw
2 = Hand primer

BLEEDING THE FUEL SYSTEM

Loosen the bleeder screw and actuate the hand primer until bubble-free fuel escapes from the bleeder screw.

Re-tighten the bleeder screw.

Continue to actuate the hand primer until resistance is noticeable.

Loosen the union nuts of the fuel-injection tubes at the injection-nozzle holders.

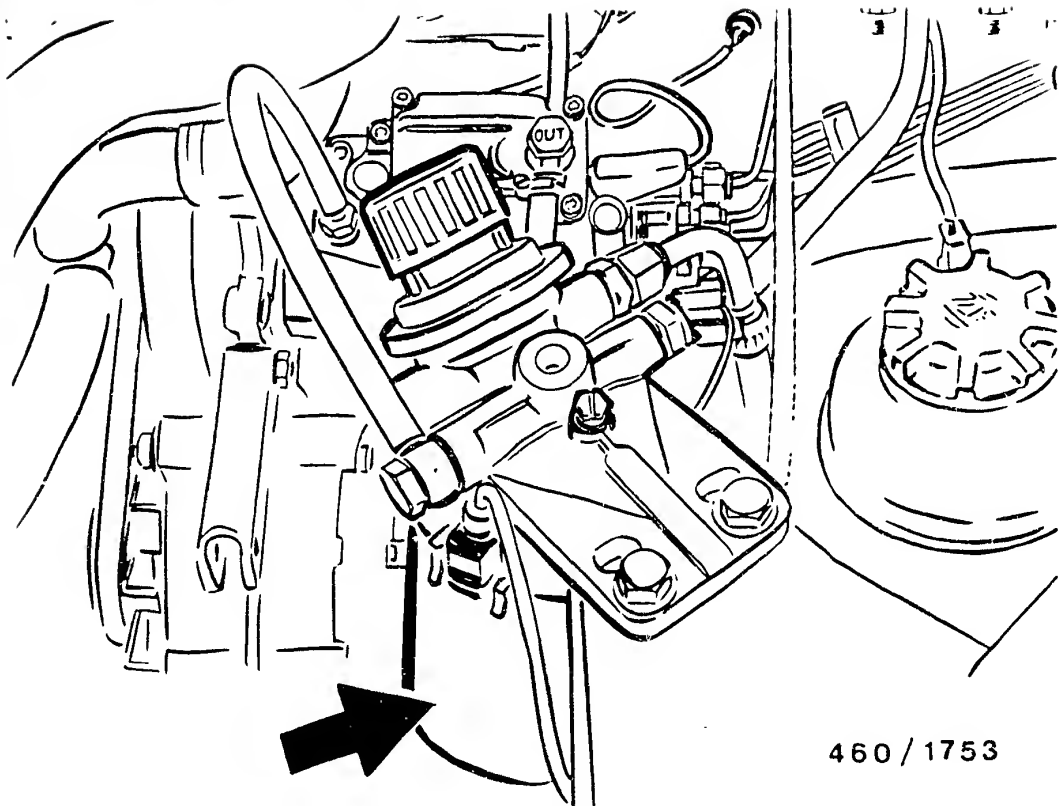
The cable connection to the sheathed-element glow plugs must be disconnected from the glow-duration control unit in order to avoid damage to the glow plugs.

Actuate the starting motor of the engine until fuel escapes from the union nuts of the injection-nozzle holders.

Tighten the union nuts.

Actuate the starting motor until the engine starts.

Return to trouble-shooting chart.



460/1753

REPLACING AND DRAINING WATER FROM THE FILTER BOX, WATER-LEVEL SENSOR

Replacing the filter box

Disconnect the cable connector.

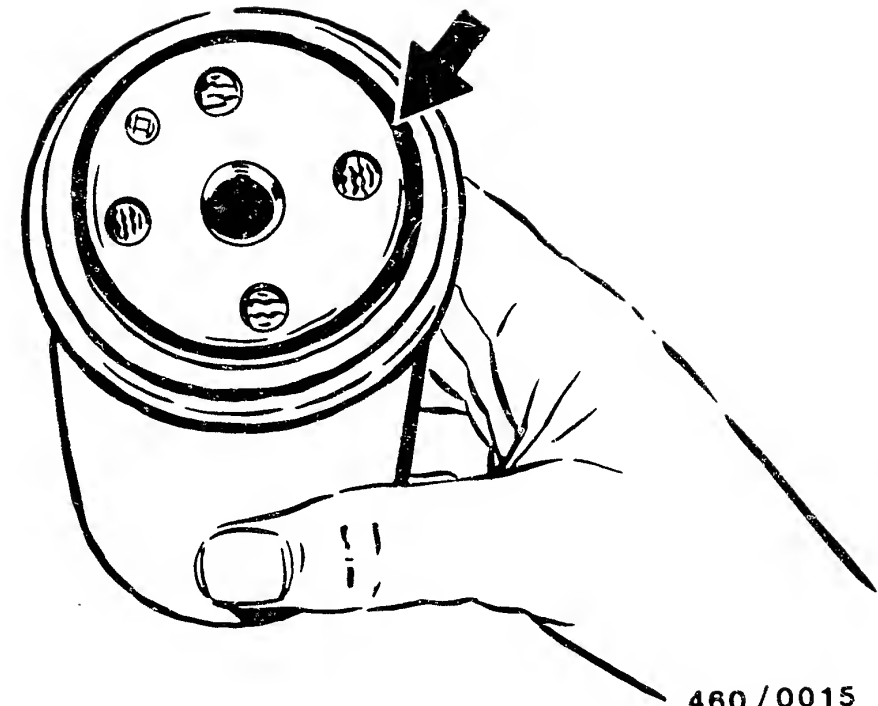
Open the drain plug with sensor and drain off fuel.

Catch the fuel which escapes.

Unscrew the fuel filter (see illustration, arrow) from the filter cover.

Unscrew the drain plug with sensor from the fuel filter.

Loosen the tightly seated filter box using a special wrench, e.g. Matra W 167.



460/0015

Lubricate the rubber gasket (see illustration, arrow) of the new filter box with diesel fuel.

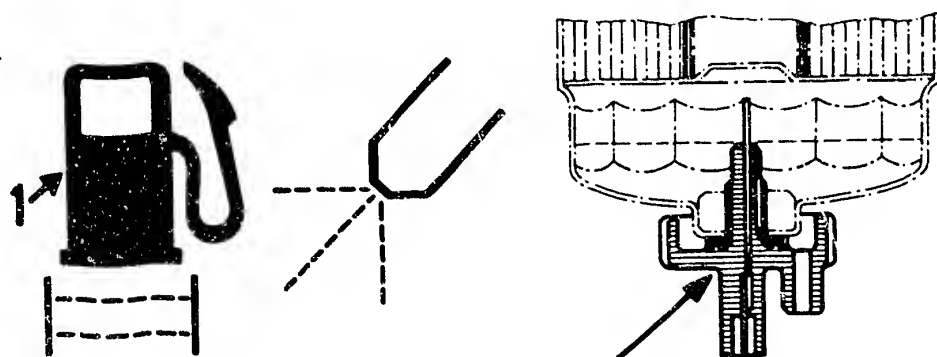
Screw in the drain plug with sensor and tighten by hand.

Screw the filter box into the cover by hand and tighten.

Test the fuel filter for leakages.

Connect the cable connector.

If necessary, in the case of winter fuel, admix gasoline in accordance with the specifications of the vehicle manufacturer.



460/2028

Draining the fuel filter.

Note :

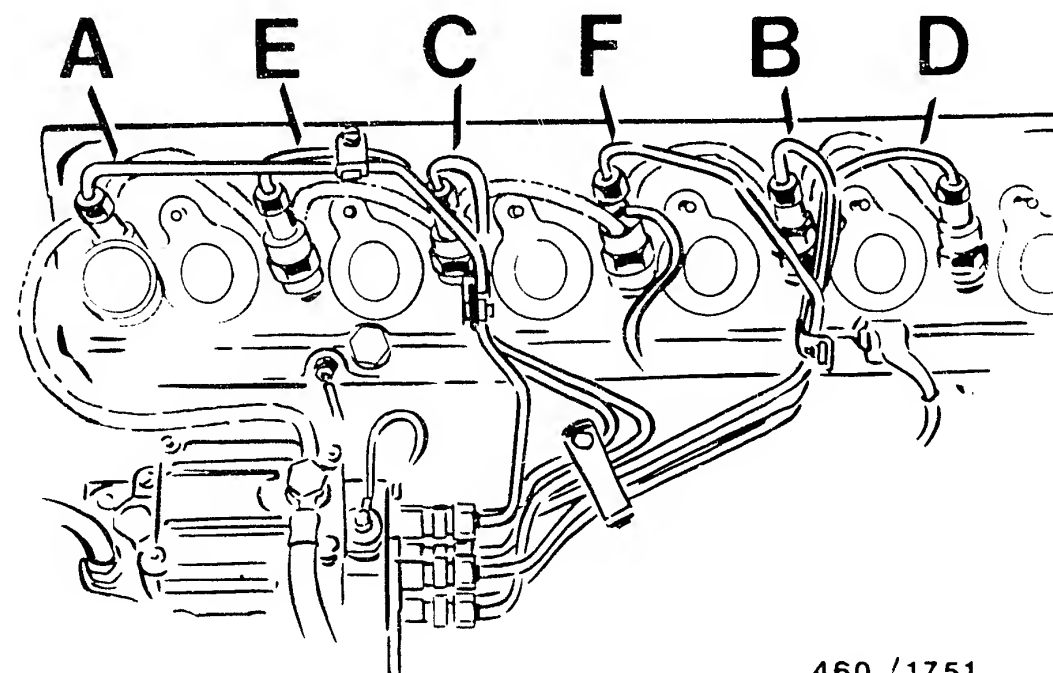
An inadmissible high water level in the fuel filter is detected by a water-level sensor and indicated via the combined water-level sensor (1)/self-diagnosis indicator (instrument panel).

Loosen the bleeder screw on the filter cover a number of rotations.

Drain off the water at the drain plug (illustration, arrow).
Catch the fluid in a container designed for this purpose.

If necessary, bleed the fuel filter.

Return to trouble-shooting chart.



460 /1751

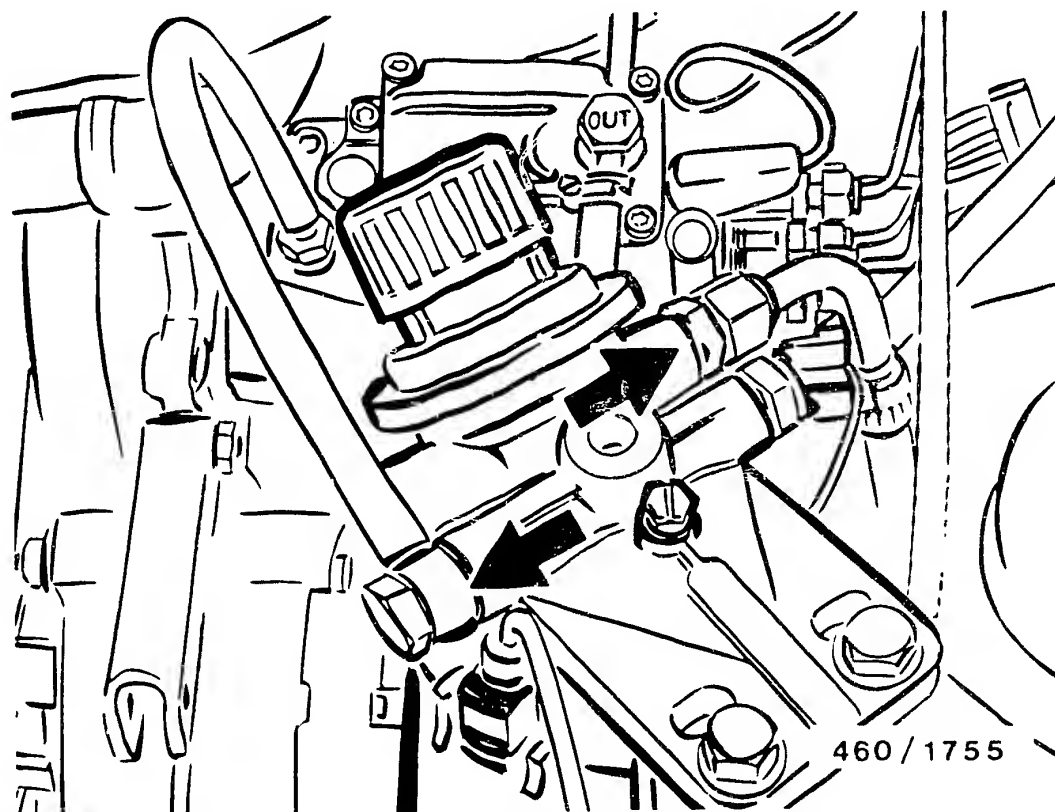
TESTING THE FUEL SYSTEM FOR LEAKAGES

Carry out the leakage test with the engine at normal operating temperature.

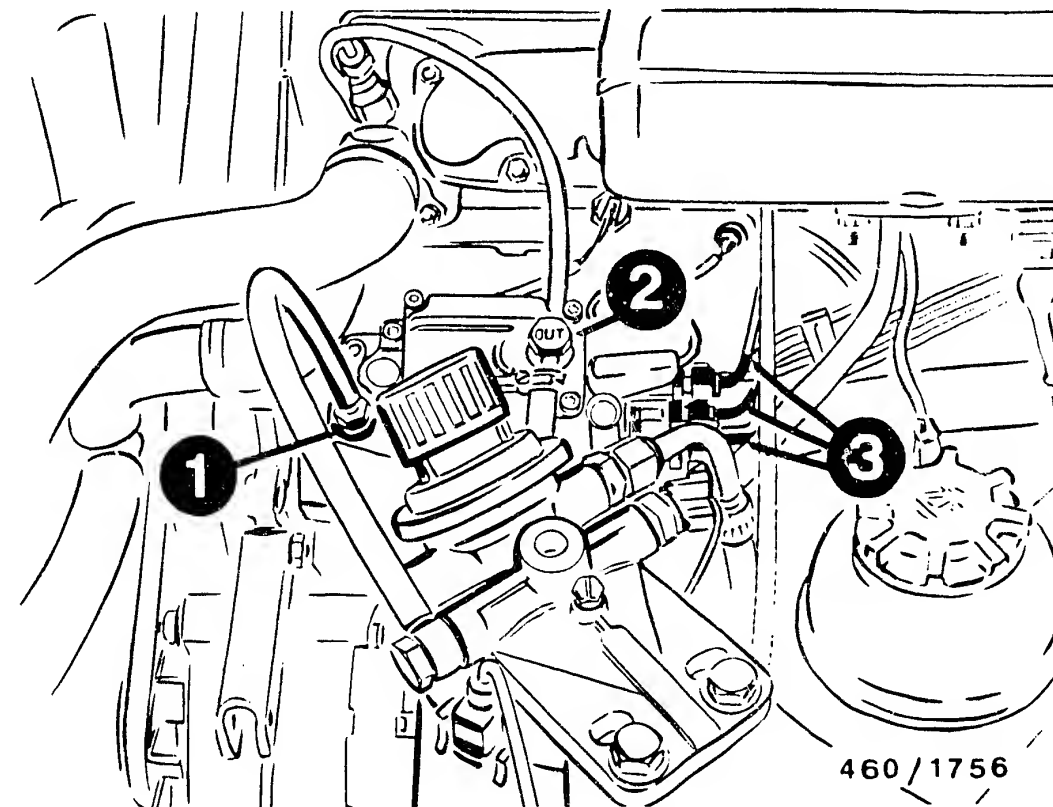
Examine all of the connection fittings of the fuel lines.

Pay particular attention to:

* Connections at the injection-nozzle holders (A...F).



* Connections at the fuel filter
(see illustration, arrows).



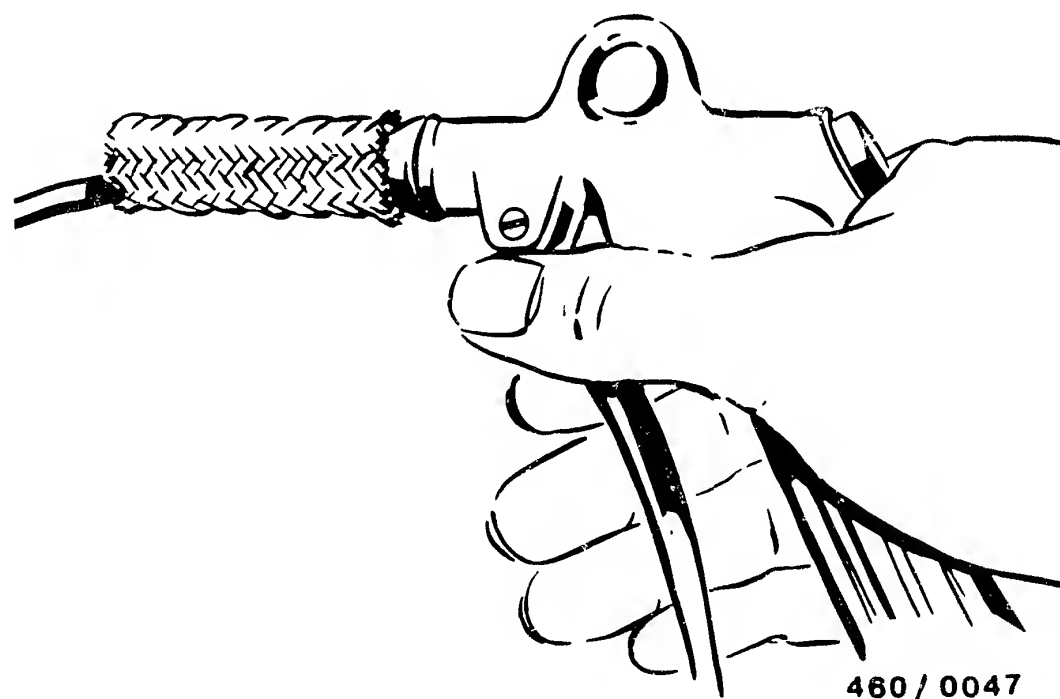
1 = Fuel-inlet line
2 = Fuel-return line
3 = Delivery-valve holder (6 pieces)

* Fuel-inlet line and return line at distributor-type fuel-injection pump.

* Delivery-valve holder at hydraulic head.

Check the fuel lines for hairline cracks.

Return to trouble-shooting chart.



TESTING THE FUEL LINES

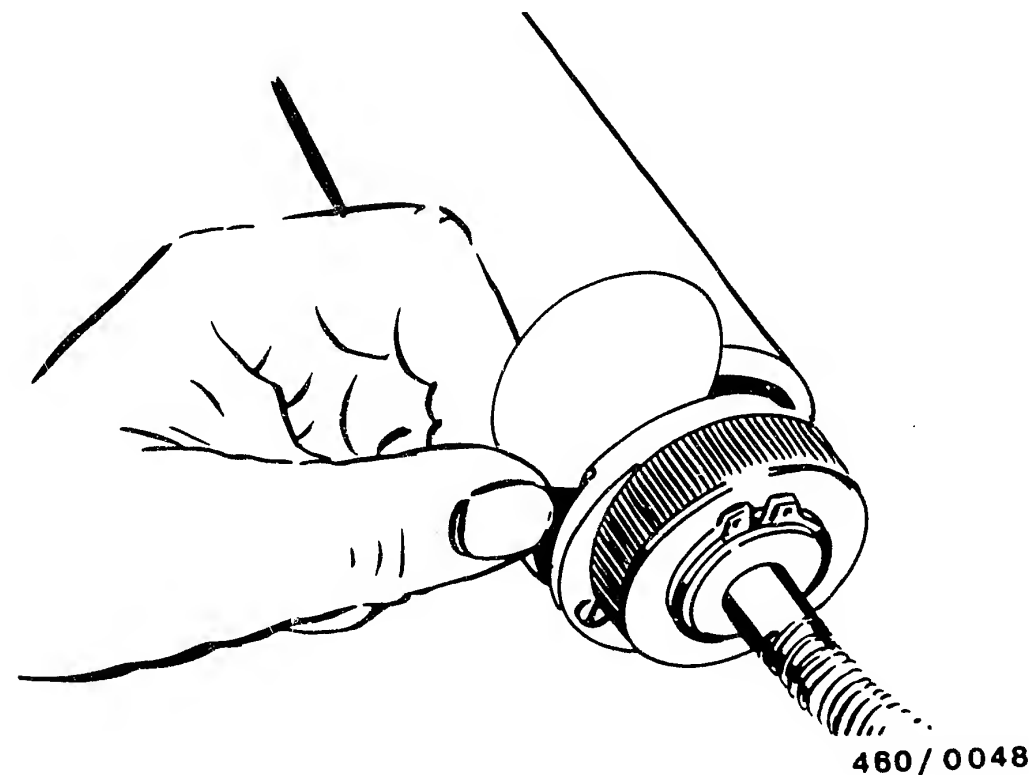
Carry out a visual examination of the fuel lines under complaint.

If no pinched or kinked locations can be detected, remove the suspect fuel line.

Check the fuel line using compressed air to make sure that it is not clogged (throughflow) and clean if necessary.

A suitable hose piece may be used for lateral sealing for blowing through the fuel lines.

Return to trouble-shooting chart.



SMOKE TEST - TESTING THE AIR FILTER

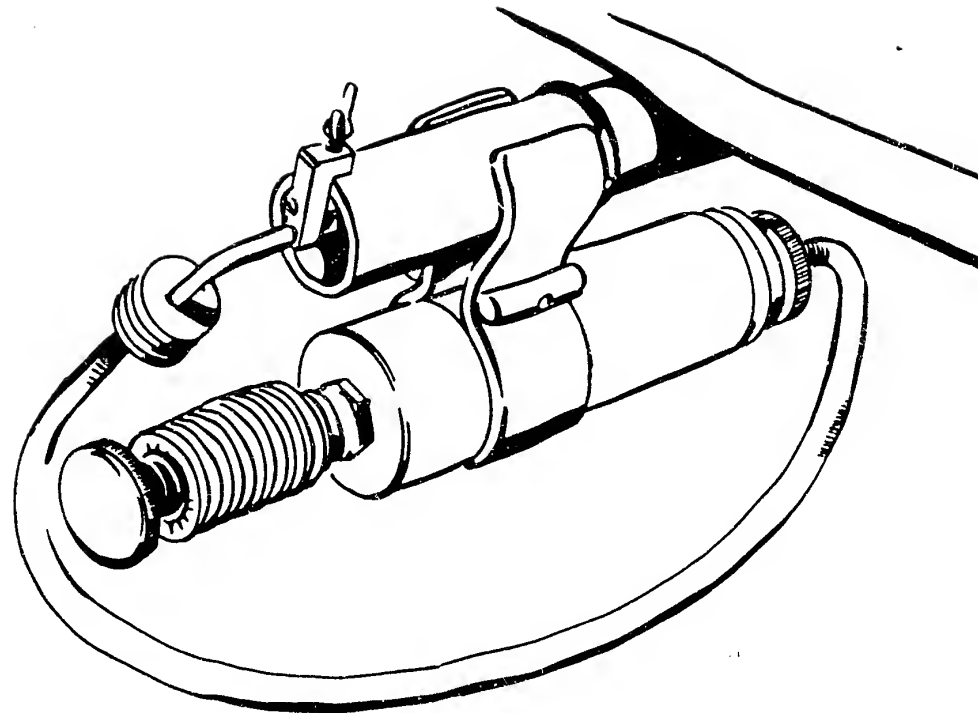
Test setup

The smoke test is carried out using the Bosch filter-type smokemeter.

The smokemeter comprises the following devices:

- * Accessories box with proportioning pump 0 681 169 038
or 0 681 169 058
- * Evaluating unit 0 684 102 050

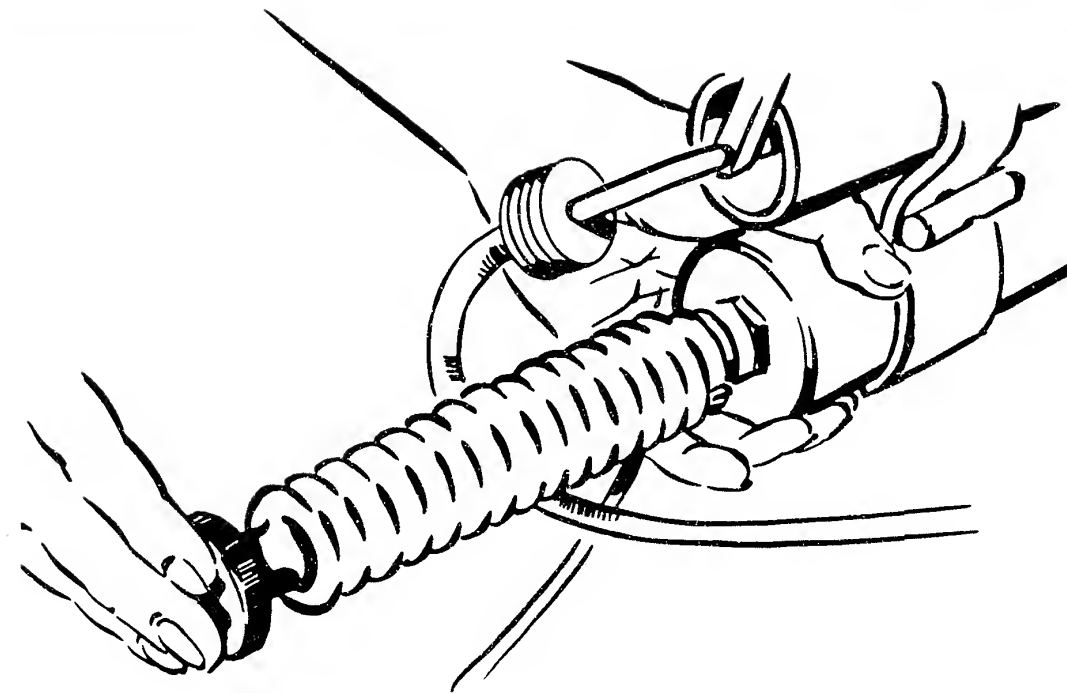
Insert the filter plate into the proportioning pump (with filter-type smokemeter 0 681 169 038).



460 / 0049

Secure the respective sampling pump to the exhaust pipe using an appropriate clamp.

Insert the exhaust-sample pickup as far as possible into the exhaust pipe and clamp.



460 / 0050

Measurement in accordance with the steady-state method

Set proportioning pump by pressing the black push-button.

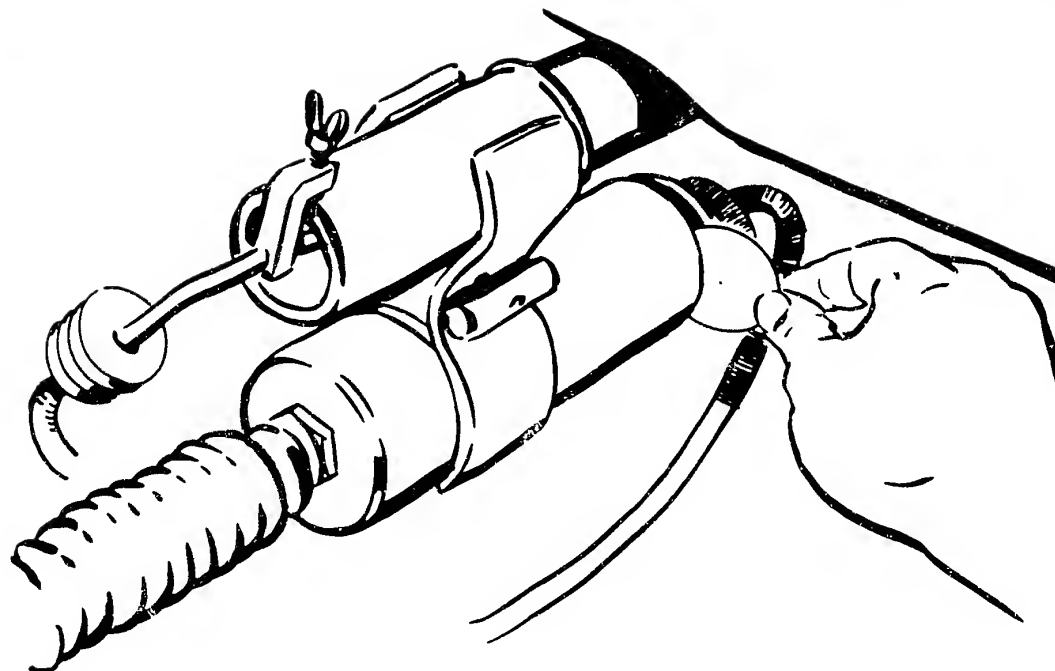
Take rubber ball on triggering hose and enter passenger compartment.

The test can be performed on the chassis dynamometer or on the road (gradient).

The chassis dynamometer is preferable in any case.

Find the gear in which, with the accelerator pedal in the full-load position, a speed of approx. 40 km/h is reached.

Load the engine, so that, with the accelerator in the same position, a speed of approx. 25 km/h is reached.



460/0051

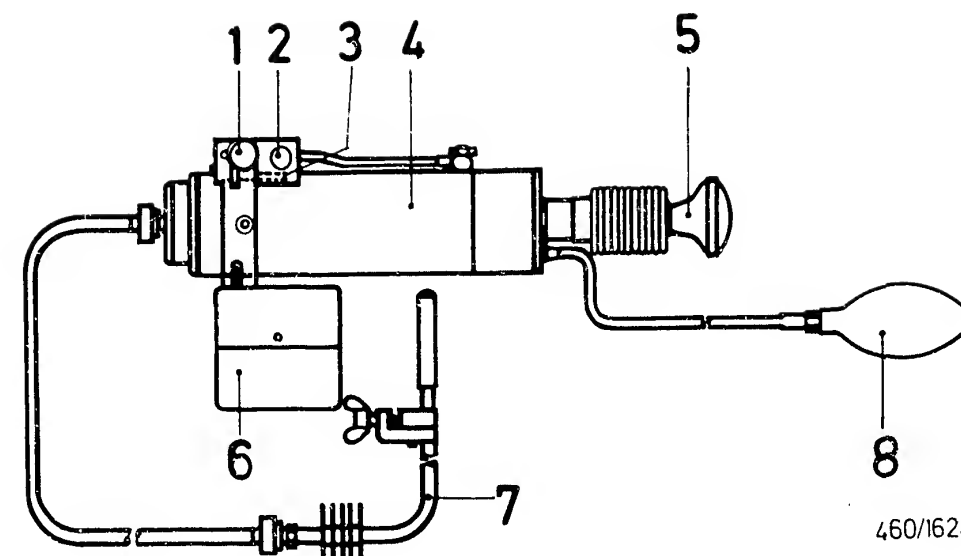
Maintain this load condition for 5 seconds and then trigger the sampling pump by pressing the rubber ball.

Switch off engine.

CAUTION!

During the following operation, pay attention to the fact that the exhaust pipe has been heated due to the running of the engine.

Remove filter plate from sampling pump.



- 1 = Rotary knob for paper transport
- 2 = Push-button for actuation via compressed air
- 3 = Compressed-air connection
- 4 = Sampling pump
- 5 = Push-button for manual actuation
- 6 = Magazine for filter-paper roller
- 7 = Exhaust-sample pickup
- 8 = Rubber ball

Measurement in accordance with the acceleration method in conjunction with filter-type smokemeter 0 681 169 058.

Operating the sampling pump:

The piston of the sampling pump can be positioned to the operating position either by hand or with compressed air.

An appropriate connection (3) and a push-button (1) are fitted for actuation by compressed air.

Clamp the sampling pump.

Test requirement:

In view of the handling and manual operation, we recommend that the measurements not be taken outdoors if it is raining or the air temperature is below 0° C.

The engine must be at normal operating temp. (coolant temp. at least 60° C) while conducting the measurement.

CAUTION!

During the following operations, pay attention to the fact that the exhaust pipe heats up due to the running of the engine.

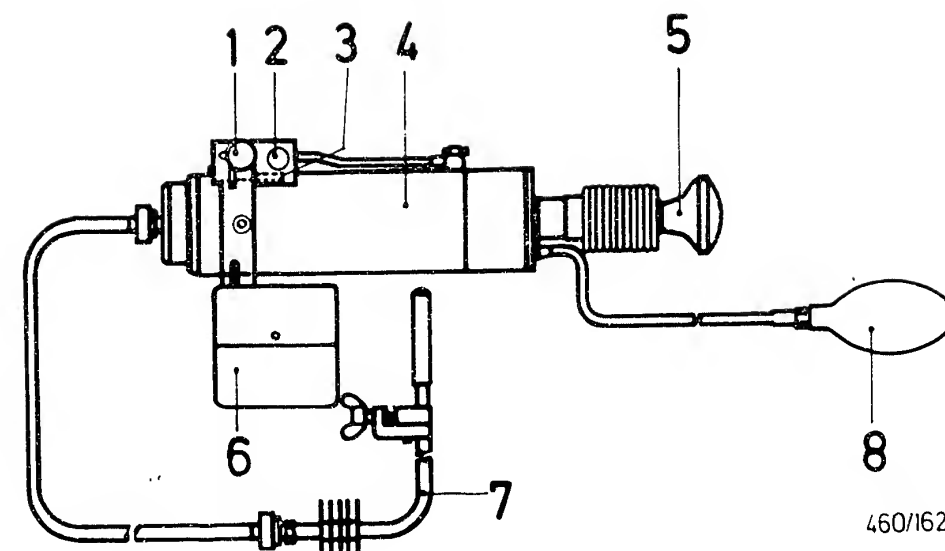
Test procedure:

In order to clean the exhaust system, accelerate the engine to its breakaway speed at least three times rapidly in succession before conducting the measurement.

Approx. 1 second before the 4th acceleration, trigger the suction stroke of the sampling pump by pressing the rubber ball.

Afterwards, rapidly depress the accelerator pedal fully to the floor until the maximum speed of the engine is reached and the governor of the injection pump regulates.

Once the breakaway speed is reached, immediately release the accelerator pedal (idle position).



- 1 = Rotary knob for paper transport
- 2 = Push-button for actuation via compressed air
- 3 = Compressed-air connection
- 4 = Sampling pump
- 5 = Push-button for manual actuation
- 6 = Magazine for filter-paper roller
- 7 = Exhaust-sample pickup
- 8 = Rubber ball

By activating the push-button (2), the piston is returned to the operating position (when testing with compressed-air supply).

Keep the push-button depressed until latching has taken place.

Transport the filter paper further by turning the rotary knob (1) one notch on (release and tensioning of the filter paper is performed automatically).

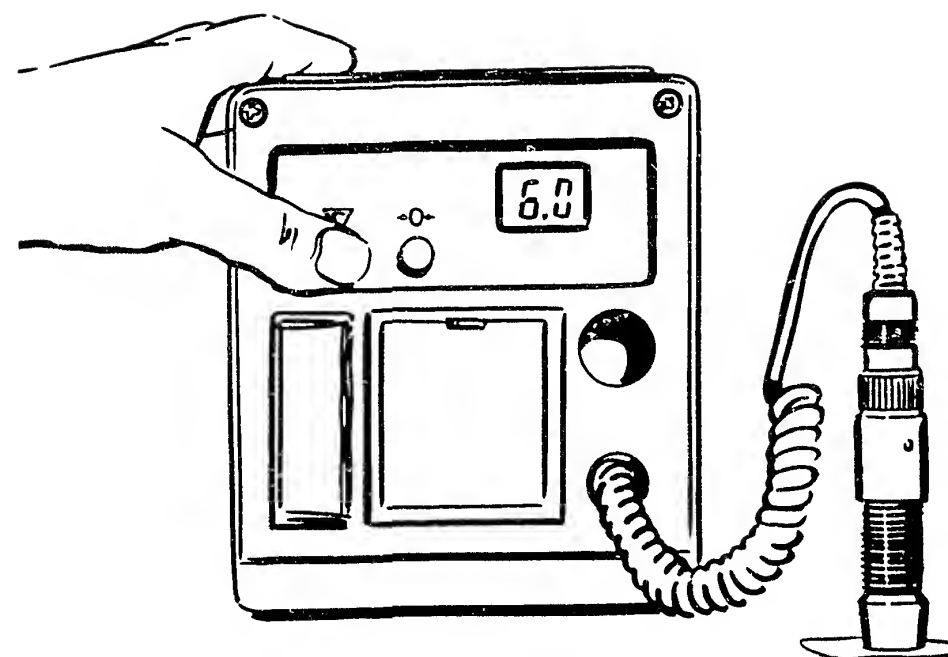
Repeat the measurement three times.

Position the piston to the operating position and tear off the measuring tape covered with soot.

With the acceleration measurement, as many individual measurements must be conducted until three successive test measurements with smoke numbers which do not deviate from one another by more than 1 Bacharach unit are obtained.

Note:

In the case of engines with selectable supercharging, the complete series of measurements must be performed with supercharging selected.



460/0756

Evaluating the filter plates

Carry out zero adjustment of the evaluating unit.

Zero adjustment must be performed:

- * before each series of measurements
- * if there are changes in the ambient conditions
- * after each time the lens of the photocell adapter is cleaned.

Firmly press the measuring head of the photocell adapter onto 5 clean, white filter plates laid one on top of the other.

Press push-button "0" until reading 0.0 appears. Release push-button "0".

Measuring

Place the filter plate from the sampling pump on to 3 new filter plates laid on top of each other, with the sooted side facing upward.

Push the measuring head vertically on to the black surface of the filter plate.

At the same time, press push-button "C" until the smoke number measured appears on the indicator.

Note:

The measuring head must be positioned firmly when performing zero adjustment and during measurement (even a slightly tilted position can lead to errors in measurement).

Compare the smoke number determined with the evaluation sheet, while noting the kW(bhp-DIN) data of the vehicle manufacturer.

Checking the air filter

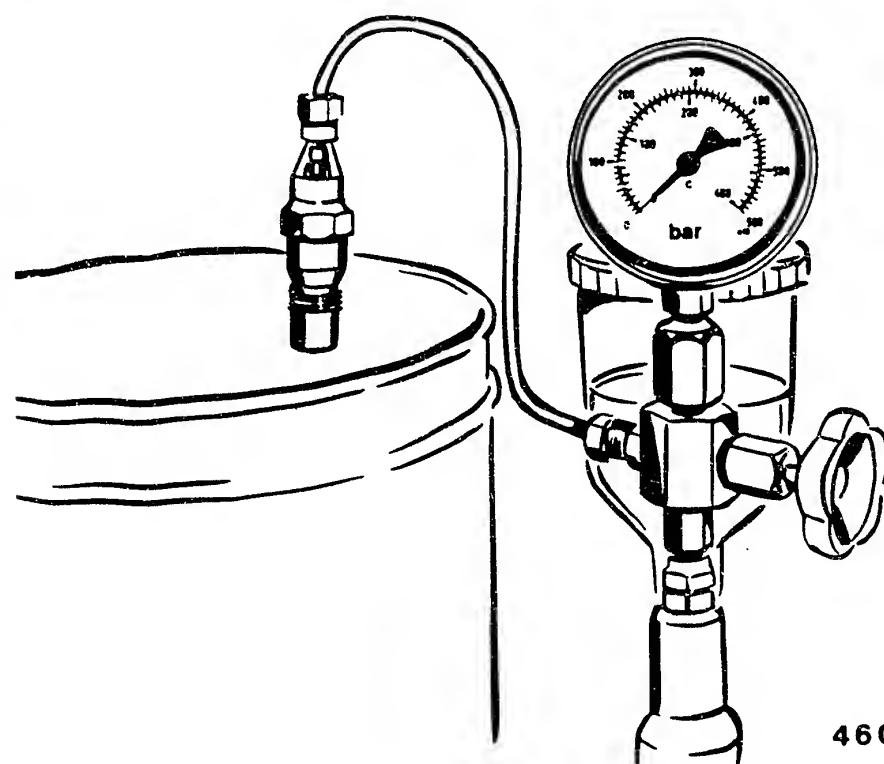
Remove the air filter and subject to a visual examination.

Test criteria for air filter:

- * Dusty air filter
(test by knocking out air filter)
- * Oil-fouled air filter
- * Solid matter in air filter, e.g. leaves.

If in doubt, use a new filter element.

Return to trouble-shooting chart.



460/0564

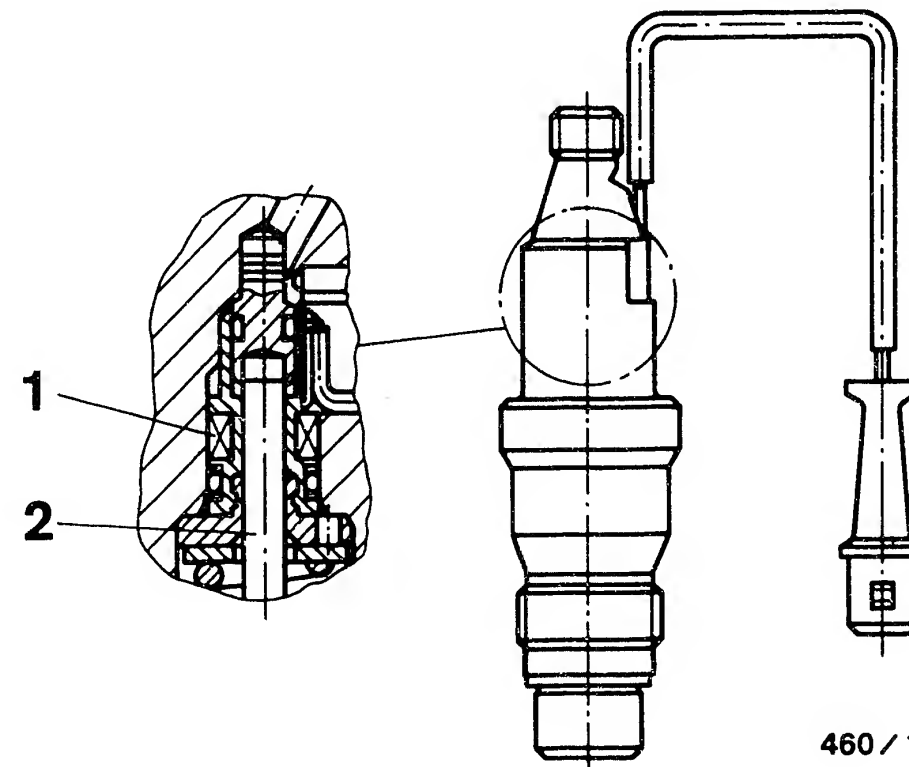
TESTING THE INJECTION NOZZLES

Remove the injection nozzles.

The test is performed using the nozzle tester EFEP 60 H, 0 681 200 502.

Mount the injection nozzle with nozzle-holder assembly onto the nozzle tester.

In order to make sure that the nozzle is correctly mounted, rapidly actuate the hand lever of the nozzle tester several times with the pressure gauge switched off (approx. 4 to 6 downward movements/second).



460/1209

1 = Needle movement sensor

2 = Spindle

Nozzle holder with inductive needle movement sensor (4th cylinder).

When replacing nozzle-holder components and/or a nozzle, there is a change in the signal voltage of the sensor coil and this results in incorrect evaluation by the start-of-injection control unit.

Renew fuel injector in the event of defective nozzle-holder components and/or nozzle.

After-sales-service workshops are only allowed to correct the nozzle opening pressure. Use is to be made for this purpose of special shims (larger central bore).

Notes:

When testing injection nozzles, make sure that the fuel spray does not strike your hands since, due to the high pressure, the fuel will penetrate into the skin and may cause blood poisoning.

For testing, use pure calibrating oil to ISO 4113 or clean diesel fuel.

Test criteria:

- * Opening pressure
- * Leakages
- * Chattering
- * Spray pattern

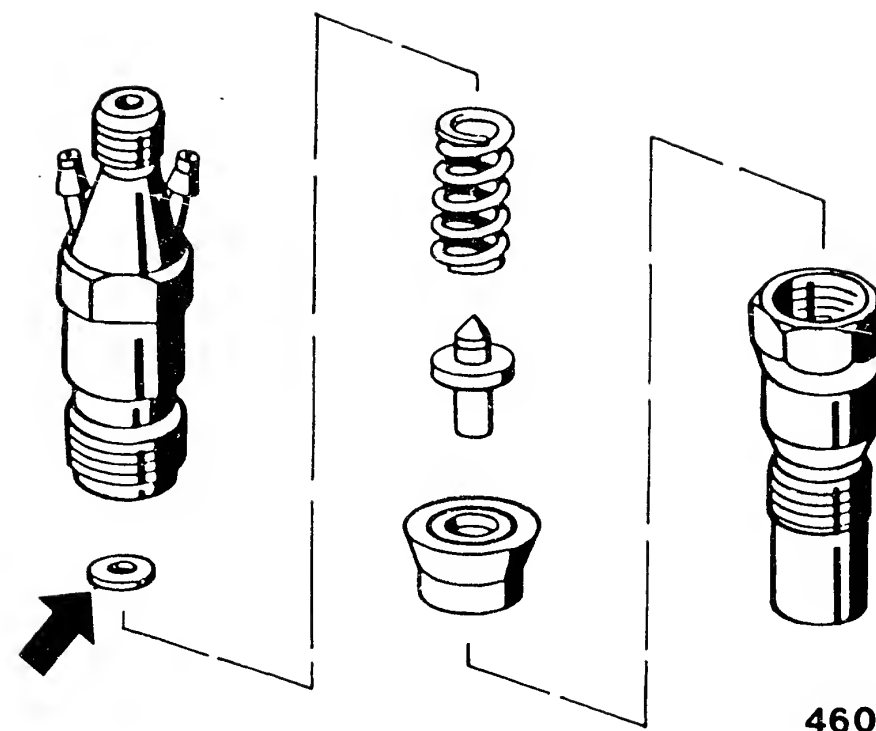
Testing the opening pressure

Open the spray valve at the pressure gauge by approx. 1/4 rotation.

Slowly push down the hand lever of the nozzle tester (pressure rise at pressure gauge).

Observe at which pressure the indicator of the pressure gauge holds a steady position (nozzle does not chatter), or the pressure drops suddenly (nozzle chatter).

The highest pressure achieved during this test is the opening pressure.



In the case of deviations from the set value, the nozzle-opening pressure must be corrected by positioning shims behind the pressure spring in the nozzle-holder assembly (arrow).

For set value, see brief instructions.

Thicker shims = higher nozzle-opening pressure
Thinner shims = lower nozzle-opening pressure

Altering the spring travel by ± 0.05 mm results in a change of the nozzle-opening pressure of approx. 5.0 bar.

Leakage test

Open the shutoff valve on the pressure gauge approx. 1/4 rotation.

Dry off the lower part of the nozzles and of the nozzle-holder assembly (blow dry with air).

Slowly push down the hand lever until the pressure gauge indicates a pressure 20 bar less than the opening pressure read off previously.

The nozzle is leakproof if no drop falls from the mouth of the nozzle within 10 seconds.

If a drop falls, dismantle the nozzle-and-holder assembly and clean it.

If there is still a leak, replace the nozzle.

Reworking the nozzle components is not permitted.

Note:

Scoring on the supporting device and intermediate shim may be reworked while taking the greatest of care (except during the warranty period).

Chatter test, evaluation of the spray pattern

General:

When evaluating the nozzles, it is necessary to differentiate between new and used nozzles.

New nozzles:

The chatter test makes it possible to audibly test the freedom of movement of the needle valve in the nozzle body. If, despite having being cleaned, the nozzle does not chatter, it must be replaced by a new nozzle. The shape of the spray is of no significance for the chatter test. A spray pattern which corresponds to that in the specifications is generally provided only by new nozzles.

Used nozzles:

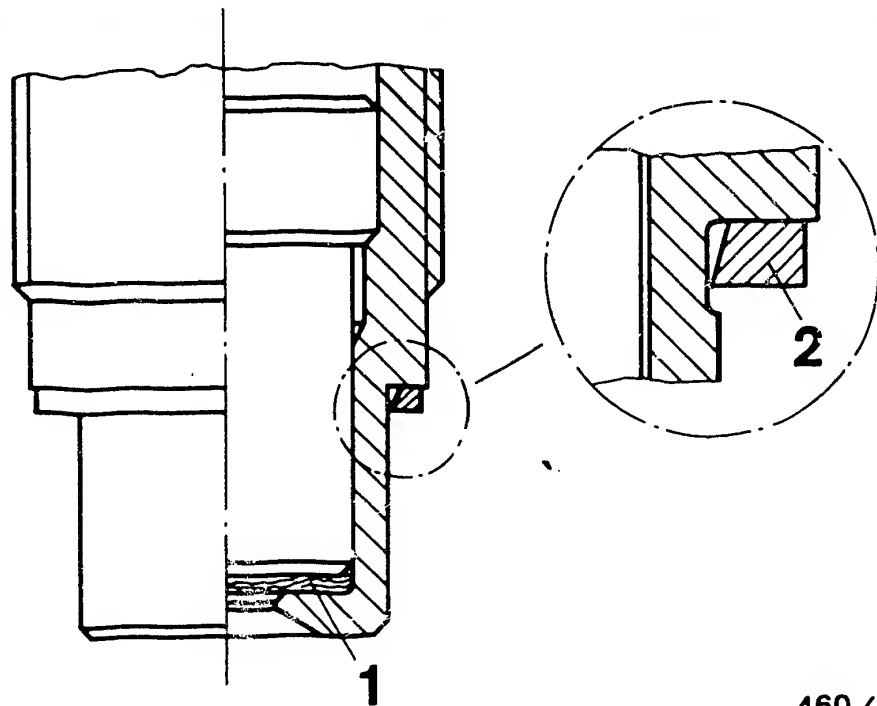
Owing to wear at the seat area, the chatter behavior of the nozzle becomes worse. The nozzle must chatter audibly and/or give a well atomized spray when the lever is actuated rapidly. In the case of used nozzles, the spray pattern may deviate from the ideal shape provided by a new nozzle. However, by applying suitable cleaning measures, it is possible to noticeably improve the spray pattern of such nozzles.

Chatter test:

Thanks to its special constructional features, this nozzle chatters very softly. A chatter test with this nozzle is possible only at between 1..2 downward movements of the hand lever per second. If the test speed is increased, chattering ceases. The calibrating oil then escapes from the nozzle with a hissing noise. Only under abrupt, rapid movement of the hand lever (approx. 4...6 downward movements per second) does the nozzle chatter with a high whistling tone.

Spray pattern (valid for new nozzles only):

Until the high whistling tone is reached, the spray may escape from the nozzle as strands and not atomized. A divided spray and streaking are not of significance in this area. For evaluating the spray shape, the hand lever is abruptly and rapidly pushed downward (4...6 downward movements per second). The spray must then be well atomized. The cross-section of the spray has an oval shape and is larger than the spray of a throttling pintle nozzle which does not make contact with the pintle.



460 / 1026

- 1 = Thermal-protection ring
- 2 = Seal ring

Installing the nozzle-holder assembly

With this type of engine, a nozzle-holder assembly with integrated thermal-protection ring (1) is installed.

The thermal-protection ring is positioned between the nozzle base and clamping nut (likewise designed as thermal protection).

After each time the nozzle-holder assembly is dismantled (opening-pressure adjustment or change of nozzle), replace the thermal-protection ring.

The seal ring (2) is firmly mounted in the recess of the nozzle clamping nut and must be replaced after each time the nozzle-holder assembly is removed.

The press-in sleeve KDEP 1562 is used for pressing on the seal ring.

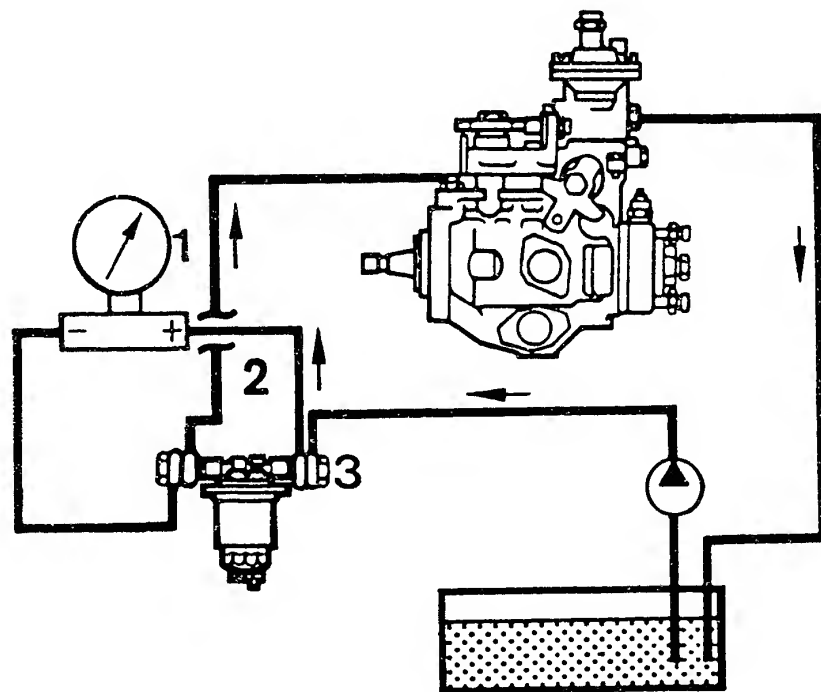
Note on installation:

Position the domed side of the seal ring pointing towards the nozzle clamping nut.
Screw the nozzle-holder assembly into the cylinder head and tighten to 40...45 Nm.

Note:

If the tightening torque is exceeded, the needle valve may jam.
Tighten the union nut of the fuel-injection tubing to 20...25 Nm.

Return to trouble-shooting chart.

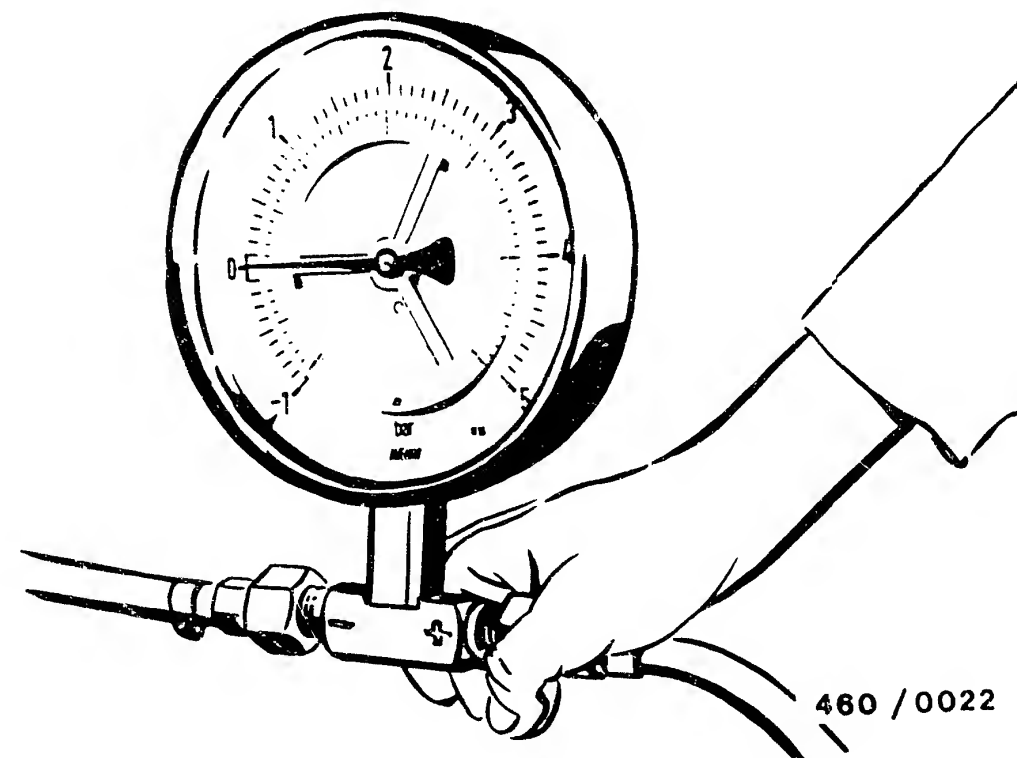


460/1017

- 1 = Differential-pressure gauge
- 2 = Filter outlet
(use inlet union and extra-long inlet-union screw 2 443 456 020)
- 3 = Filter inlet
(use inlet union and extra-long inlet-union screw 2 443 456 020).

TESTING THE FUEL FILTER (DIFFERENTIAL-PRESSURE TEST)

Connect the differential-pressure gauge via appropriate connecting pieces to the fuel filter.



460 / 0022

Connect the differential-pressure gauge with the side marked "+" to the fuel-filter inlet.

Connect the (-) connection of the pressure gauge to the filter outlet.

Observe the connection diagram.

Leave the engine running until it is certain that there is no air in the fuel system.

Move the accelerator pedal for approx. 1 second from idle position to the full-load position.

Release the accelerator pedal and read off the differential pressure on the pressure gauge.

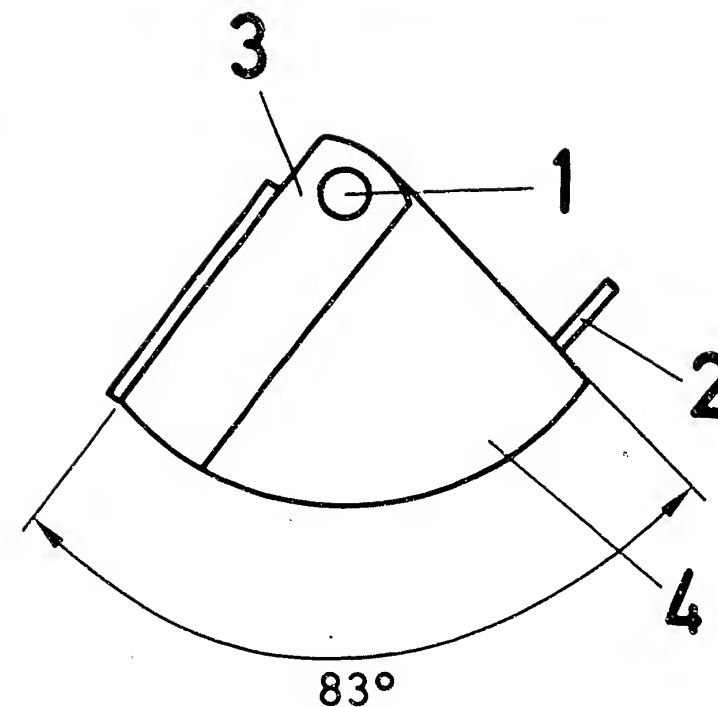
The differential pressure must be a maximum of 0.3 bar.

If this value is exceeded, exchange the filter.

Remove the test connections.

If necessary, bleed the fuel system of air.

Return to trouble-shooting chart.



460/1757

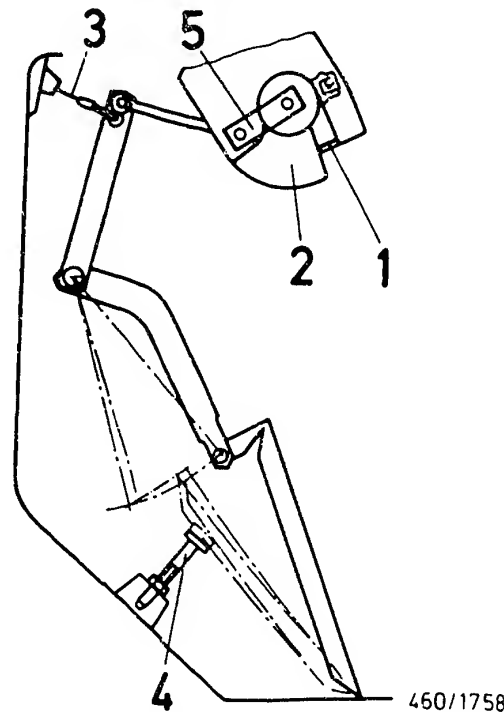
- 1 = Throttle-sensor shaft
- 2 = Stop on holder, throttle sensor
- 3 = Lever for throttle sensor
- 4 = Feeler gauge (BMW 12 7 100)

INSTALLATION INSTRUCTIONS FOR PEDAL-OPERATED SENSOR

Install throttle sensor.

Attach lever (3) to throttle-sensor shaft.

Set angle of 83° (82°...84°) between lever for throttle sensor (3) and stop on holder for throttle sensor (2) with feeler gauge (4).



- 1 = Stop on holder, throttle sensor
- 2 = Feeler gauge (BMW 12 7 100)
- 3 = Bowden cable
- 4 = Knurled screw
- 5 = Lever for throttle sensor

Adjustment specifications

Idle position:

Tighten hexagon nut at throttle-sensor shaft to torque 7...9.5 Nm (use throttle-sensor lever for support).

Full-throttle position:

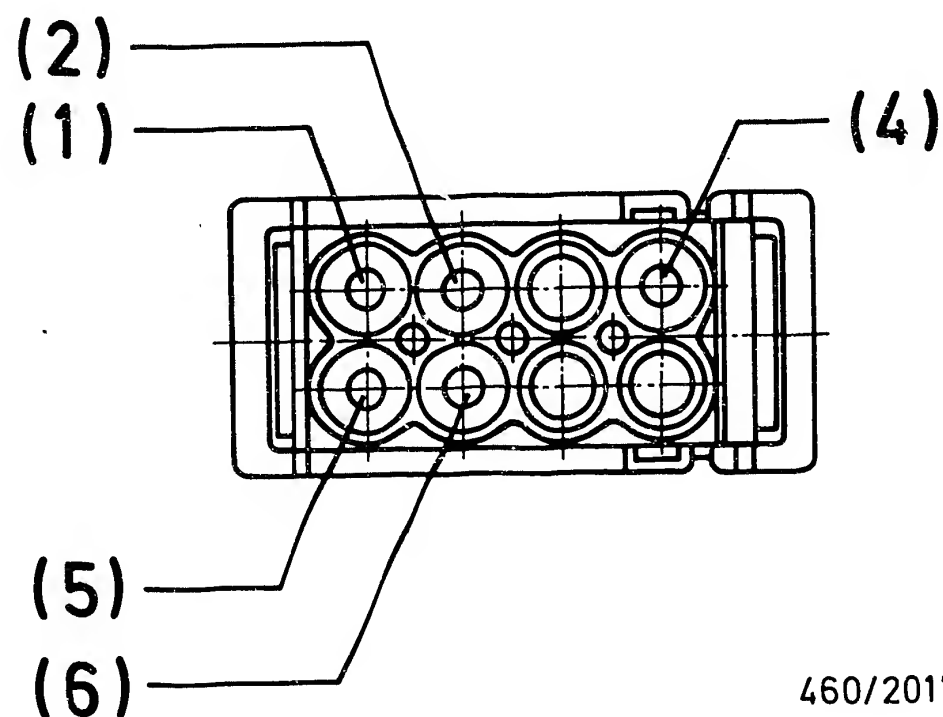
1. Manual transmission

Depress accelerator pedal as far as kick-down pressure point (in throttle sensor).

In this position, cause knurled screw to make contact with accelerator pedal and lock.

2. Automatic transmission

Actuate the accelerator pedal up to the kick-down pressure point (in accelerator-pedal sensor). In this position, set the knurled thumbscrew so that there is a clearance of 6 mm between the screw head and accelerator pedal. Lock the knurled thumbscrew. Adjust bowden cable to transmission. Adjust bowden cable from accelerator-pedal lever so that it is free of tension.



460/2017

Perform voltage test after adjusting throttle sensor.

Accelerator pedal in idle position.

Measurement is performed between term. 1 and term. 2 at plug connection.

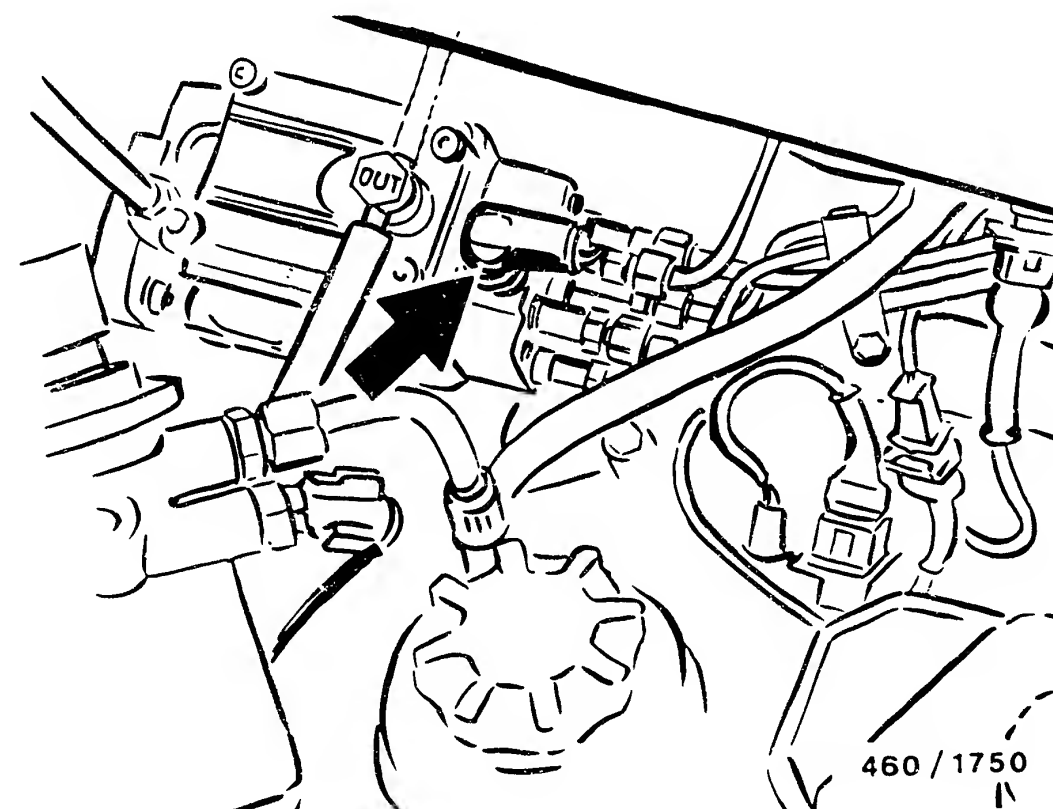
Set values:

Idle 350...450 mV

Full-load setting max. 3.2 V

Correct adjustment if set values are not attained.

Return to self-diagnosis test table/trouble-shooting chart.



460 / 1750

MEASURING THE ENGINE COMPRESSION AND COMPRESSION LOSS

Measuring the engine compression

Fit a new chart in the compression tracer.

Mount the high-pressure hose on to the tracer.

Switch off the engine.

In order to prevent fuel from being injected, remove the connecting cable from the shutoff magnet of the distributor-type fuel-injection pump (illustration, arrow).

Disconnect lead to sheathed-element glow plugs at glow-duration unit.

Unscrew sheathed-element glow plugs and use suitable connecting nipple for compression gauge.

Crank engine several times with the aid of the starting motor so as to remove loose residue from compression chamber.

Screw in connecting nipple.

Attach high-pressure hose of compression gauge to connecting nipple.

Pay particular attention to first compression stroke during following operation.

Actuate starting motor until no further increase in pressure is recorded on the compression tracer.

Vent compression tracer by pressing on vent valve.

The pointer returns to its initial position.

Move chart to next position.

Attach connecting nipple to following cylinders and repeat measurement.

Compression:

See brief instructions for set values

Permissible cylinder deviation:

See brief instructions for set values.

Evaluation of the chart

Normal pressure rise:

If the piston rings and valves are in good condition, the first compression stroke shows the highest pressure increase.

During the following compression strokes, the compression builds up to the maximum pressure.

Gradual pressure rise:

If, from the start, the compression increases only gradually on each piston stroke, this points to burnt valve seats or defective valve guides.

Low maximum pressure:

If the maximum pressure obtained is too low on all cylinders, this points to defective pistons, piston rings or valves.

If the compression is too low on two neighbouring cylinders, this points to a leaky cylinder head gasket.

Varying compression

If one cylinder shows a clearly lower compression, proceed as follows:

Pour in 2...3 cm³ of engine oil through the opening of the sheathed-element glow plug or nozzle-holder assembly and operate the starting motor briefly.

Repeat the measurements and compare charts.

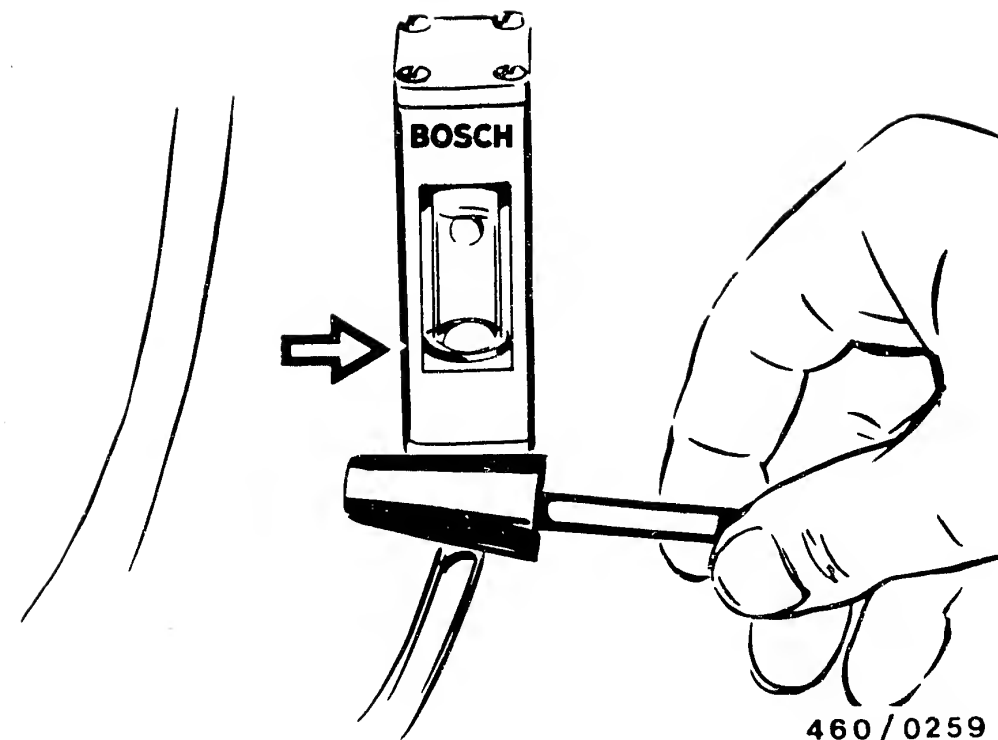
If there is a clear increase in compression during the second test, then the piston rings or cylinders are worn.

If there is no change in the result, then defective valves are the cause.

Uniform compression

Uniform compression is extremely important with regard to the smooth running of the engine.

Maximum compression is, therefore, not the only objective.



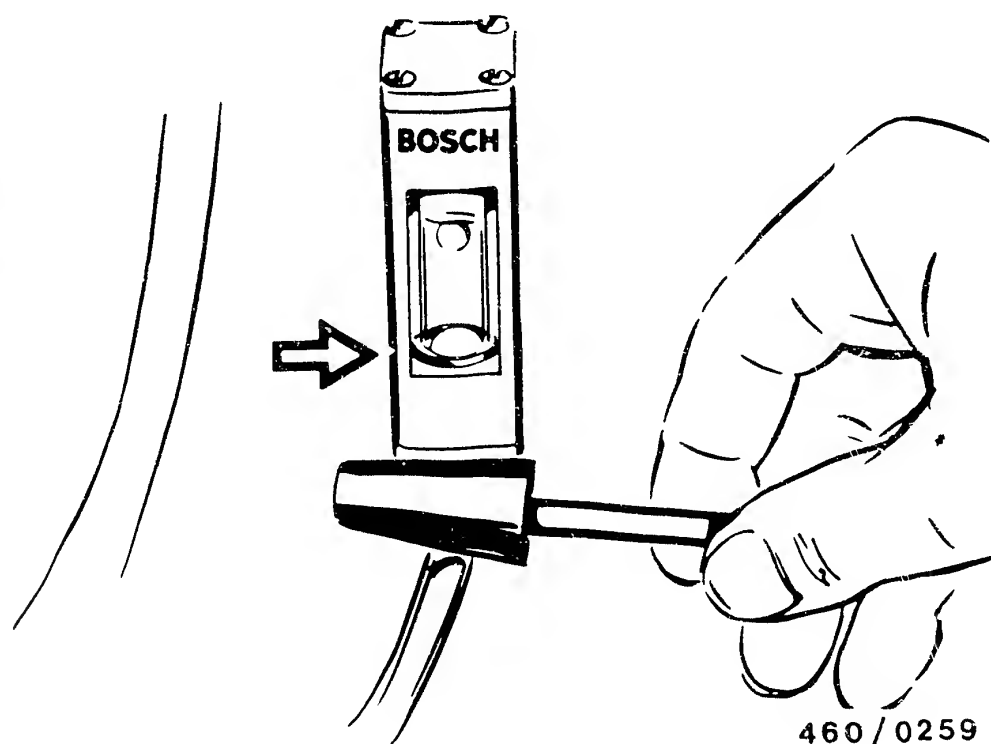
Measuring the compression loss of the engine

The test is performed using the
BOSCH compression-loss tester 0 681 001 901
(EFAW 210 A).

For testing, the respective piston must be at TDC
(TDC = top dead center) of the compression stroke.

For setting this position, use the DC detector
1 688 132 025 (included with accessories with
compression-loss tester).

Perform the test with the engine at normal operating
temperature (temperature of water approx. 80°C).



460 / 0259

Setting top dead center

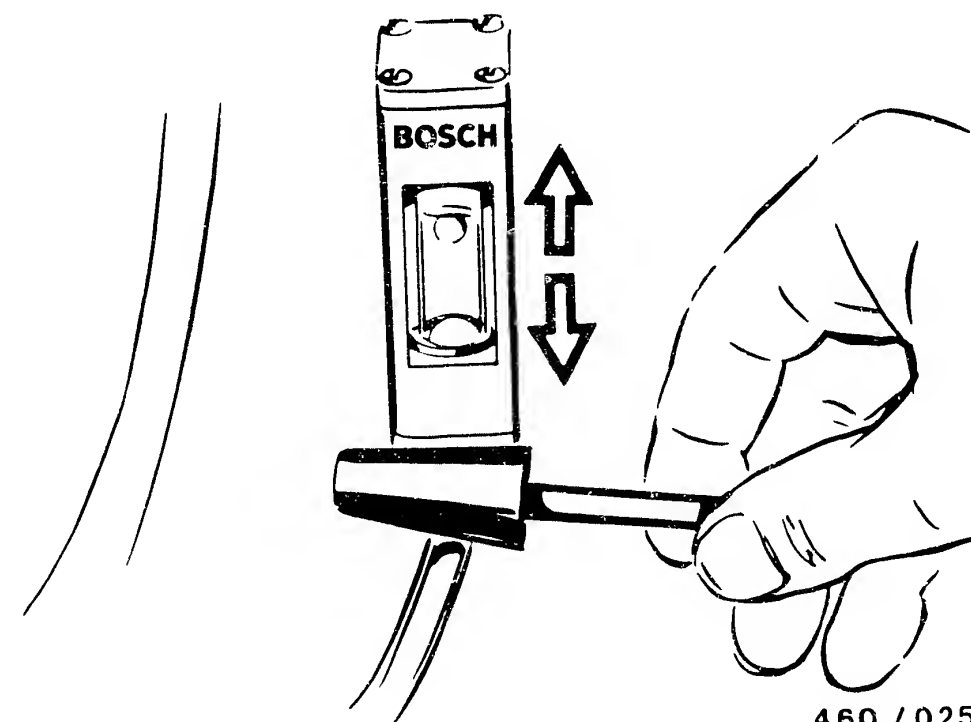
Remove the sheathed-glow plug from cylinder 1.

Insert the rubber plug of the DC detector into the bore of the sheathed-element glow plug.

Using a magnetic clamp, mount the glass cylinder in as vertical a position as possible in the engine compartment.

The piston of the unit must be clearly visible.

Slowly turn the engine over by hand in its direction of rotation.
(If necessary, select a gear and push the vehicle).

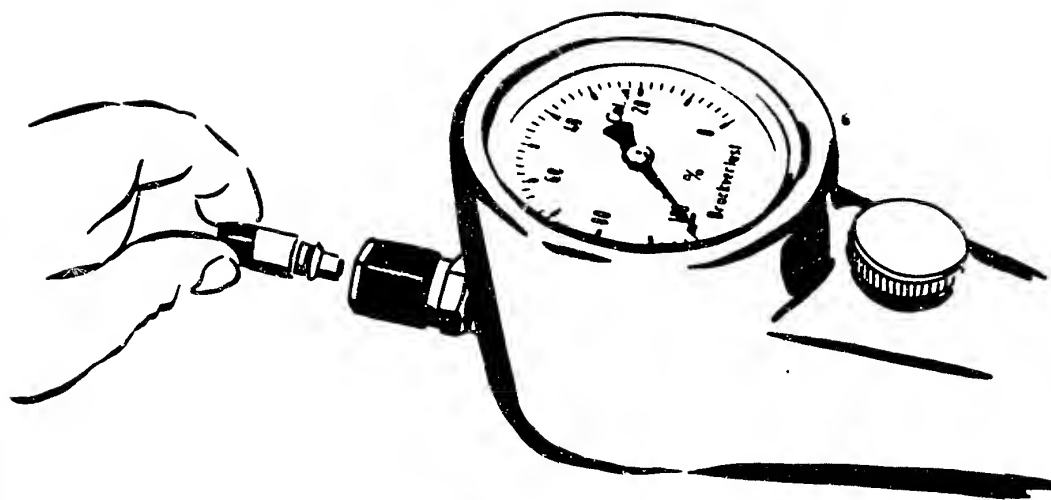


460 / 0256

On the compression stroke, the piston of the DC detector is forced upward.

As the top dead center is passed over, the piston slides down again immediately.

Locate top dead center by carefully turning the engine backwards and forwards.



460/0057

Measuring the compression loss

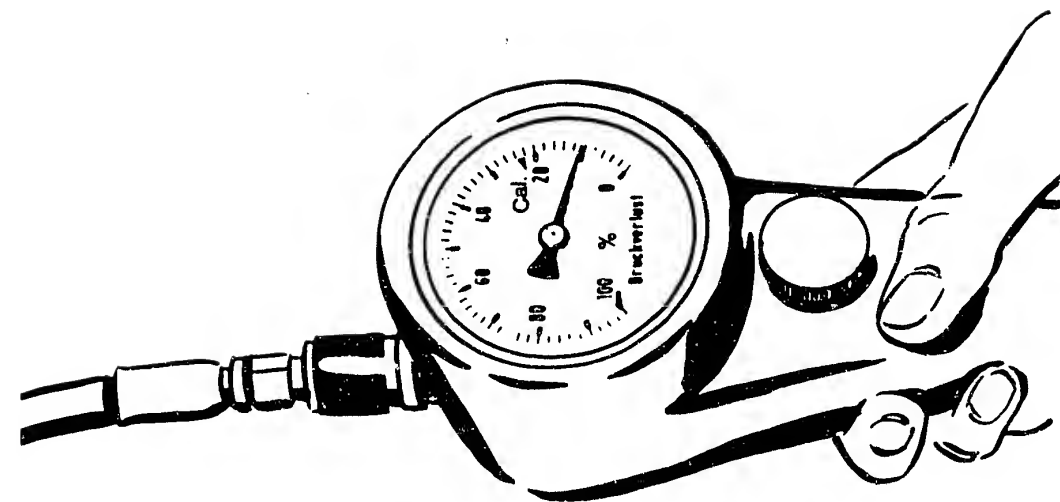
Connect the tester to the compressed-air mains.

Connect the calibrating nozzle 1 680 363 036.

Set a compression loss of $23 \pm 1\%$ (marking "Cal.") at the knurled thumbscrew on the pressure-regulating valve.

The instrument indicator may deviate from the zero position by plus/minus one graduation mark.

If this is not the case, the tester is defective..



460/0058

Screw in the fitting and mount the test hose.

Select a gear and pull on the handbrake.

Connect the test hose to the tester.

Read off the compression loss in % on the instrument.

Note:

Before testing the next cylinder, turn the engine over briefly using the starting motor without pre-heating, so that the oil film re-forms.

Evaluation of the test

The compression loss indicated should not exceed 25%.

Differences of 10 % between the individual cylinders can be ignored.

The causes of greater losses can be located because the air makes a noise as it escapes.

Listen at the following points:

Location of noise	Possible trouble
Intake manifold (remove air filter)	Intake valve
Exhaust manifold	Exhaust valve
Oil filler neck on engine	Pistons, piston rings
Cooling-water filler neck (air bubbles)	Cylinder-head gasket

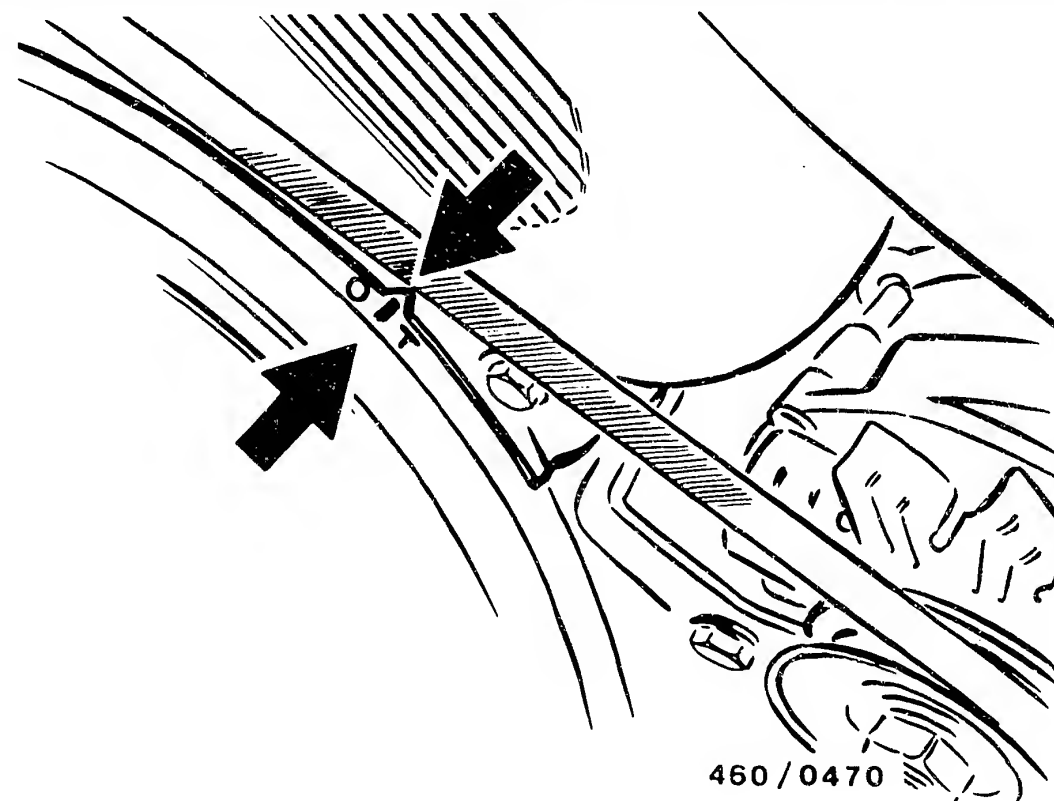
In order to trace the trouble even more accurately, fill approx. 2...3 cm³ of engine oil into the cylinder.

Repeat the test.

If there is a clear decrease in compression loss during this test, then the fault lies with the piston or with the piston rings.

New engines which have not yet been run in (less than 5 000 km) may show higher compression losses than after the running-in period.

Return to trouble-shooting chart.

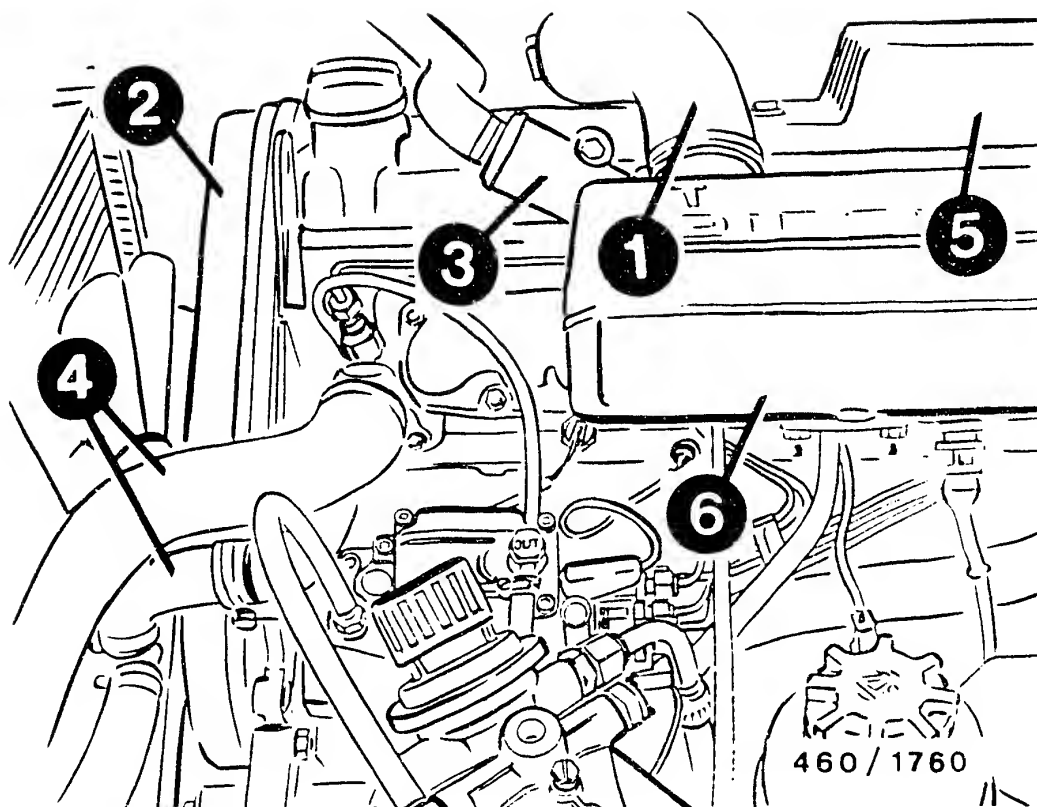


REMOVING THE INJECTION PUMP

Disconnect the negative cable from the battery.

Turn the crankshaft until the TDC marking (cylinder 1) on the pulley aligns with the reference marking (arrow).

The piston of cylinder 1 is at TDC (the valves of cylinder 6 are overlapping).

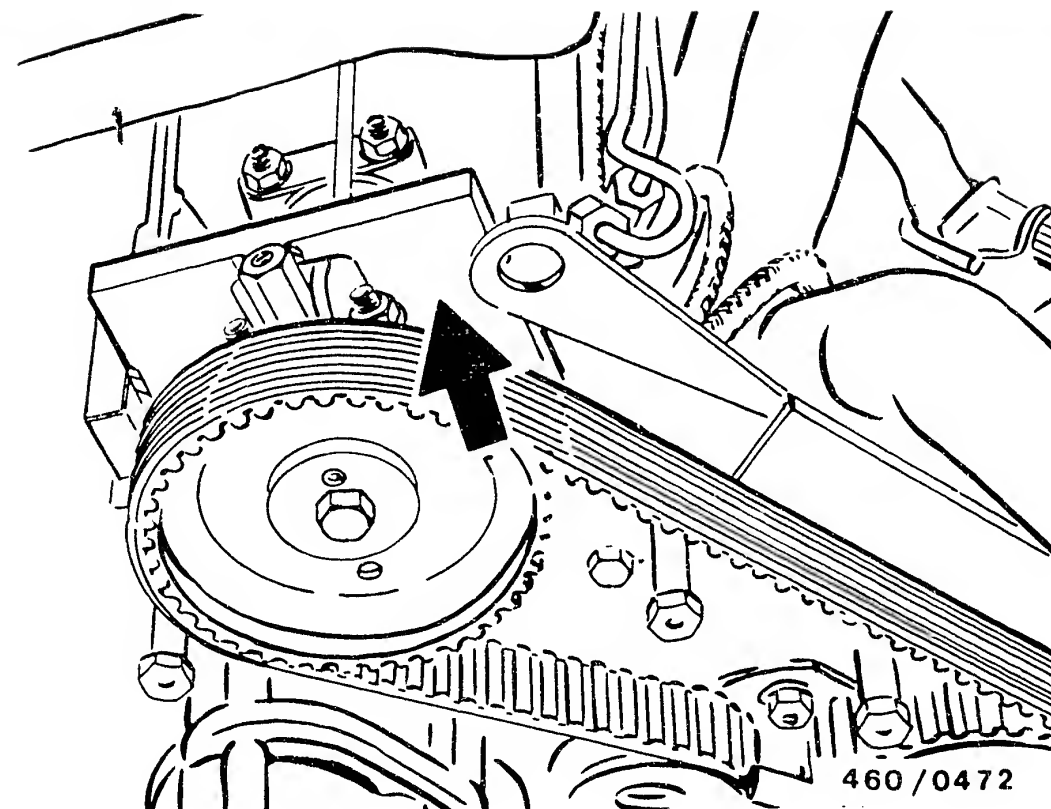


- 1 = Intake bridge
- 2 = Toothed-belt cover
- 3 = Crankcase ventilation
- 4 = Coolant hose
- 5 = Cylinder-head cover
- 6 = Air collector

Remove the intake bridge, vacuum connection (not shown in picture), and crankcase ventilation.

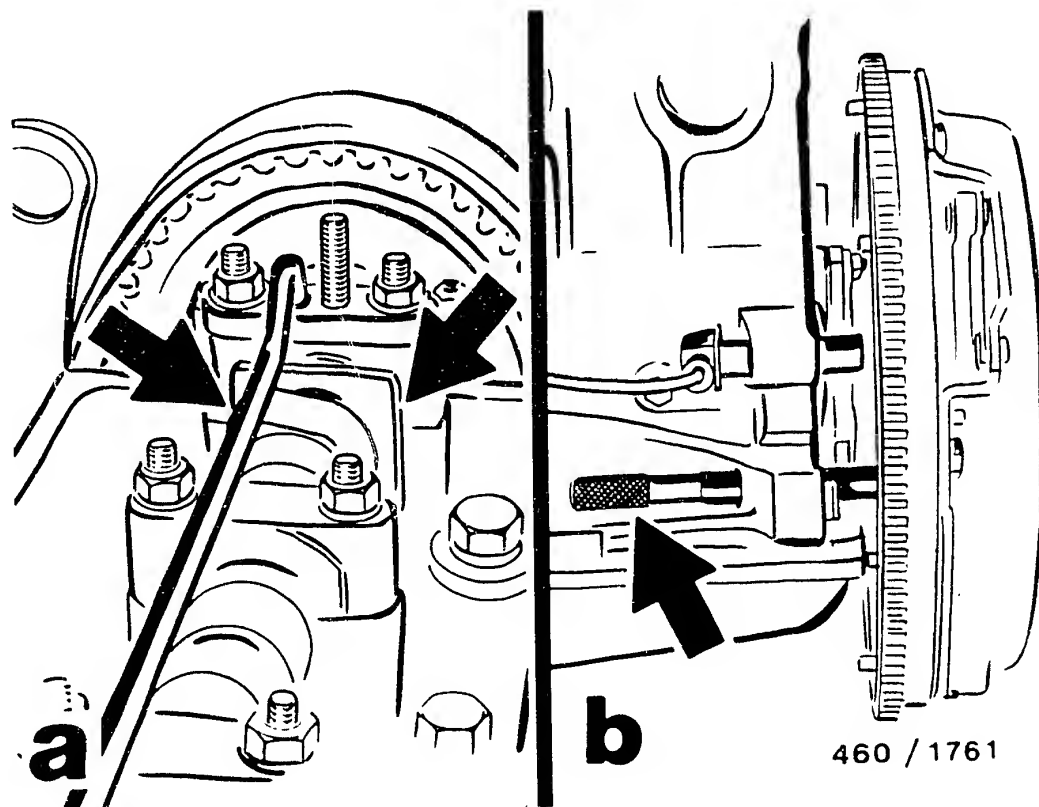
Remove coolant hoses (catch coolant).

Remove toothed-belt cover, cylinder-head cover and air collector.



Lock the camshaft using stop device (KDEP 1136), (illustration, arrow).

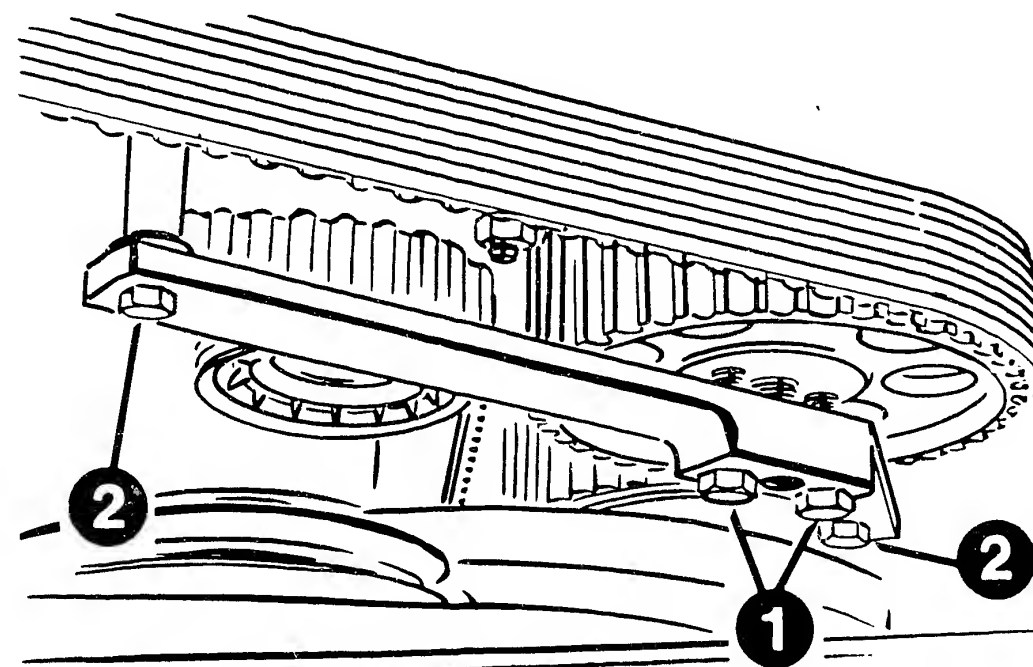
Valves of cylinder 6 are overlapping.



460 / 1761

Note:
The stop device fits only over the 2 worked surfaces of the square (arrows, illustration a).

Lock the flywheel using setting mandrel KDEP 1139 (arrow, illustration b).
If the setting mandrel cannot be inserted, adjust the engine timing.



460 / 1481

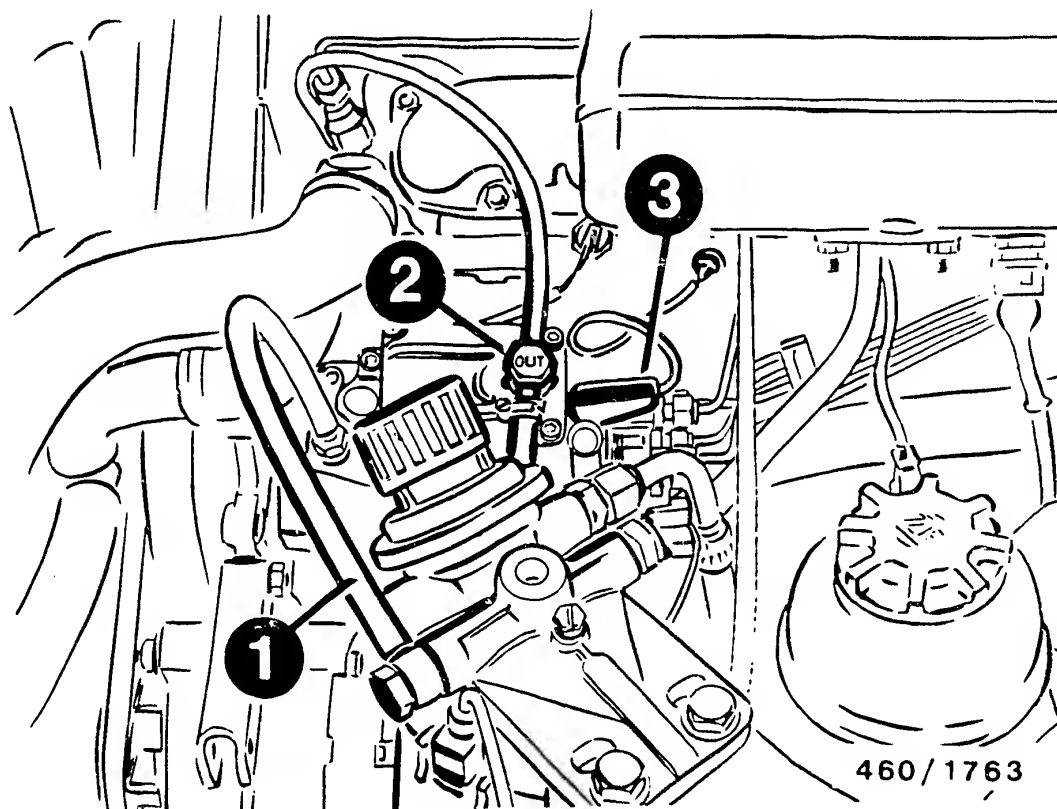
Lock the injection-pump gear using setting mandrel KDEP 1138 and remove again after unscrewing the fastening nut (arrow, illustration a).

Locate the injection-pump gear using the holding and press-off device KDEP 1156.

To do this, screw the fastening screws (1) into the injection-pump gear and screws (2) into the mounting bolt of the toothed-belt protective cover.

Note :

If the screws (2) cannot be secured, remove the setting device and alter the position of the gear.



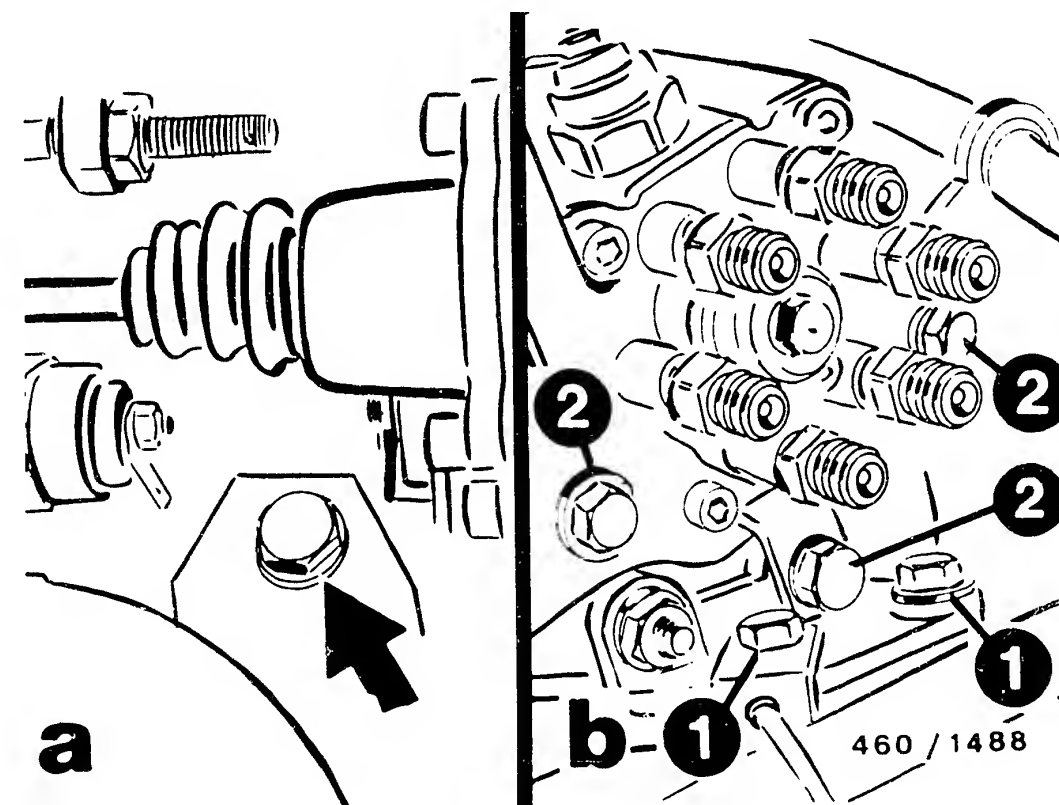
- 1 = Fuel inlet line
2 = Fuel return line
3 = ELAB

Remove the fuel inlet line and fuel return line.

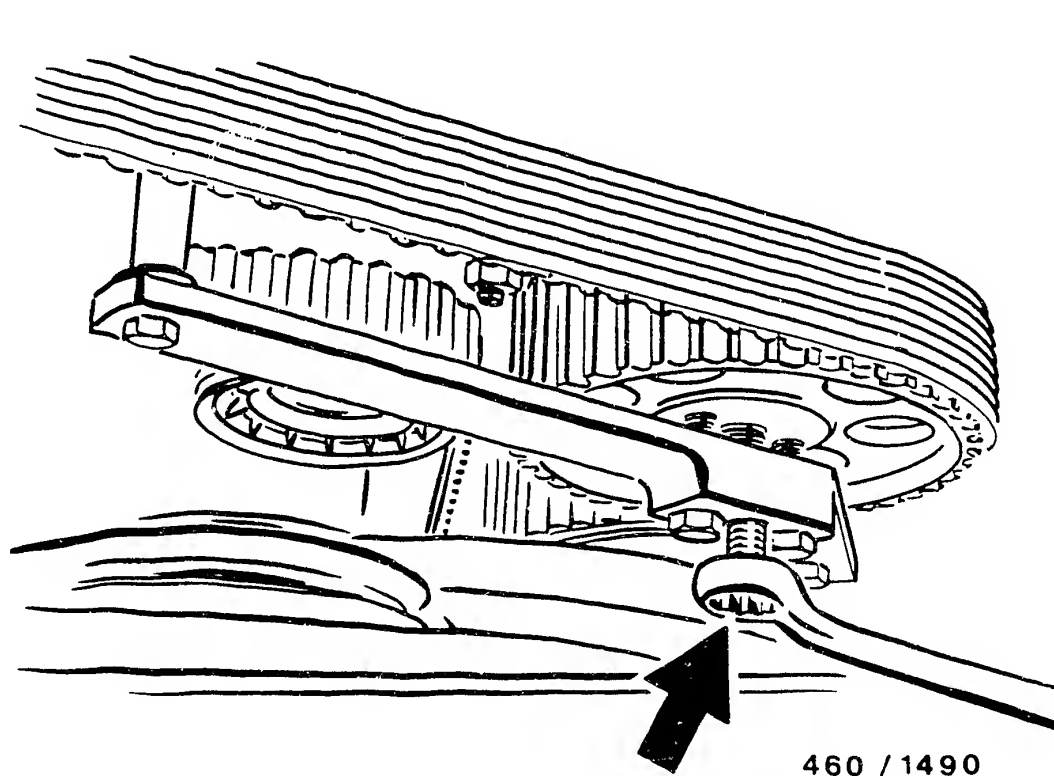
Remove the electrical connection lead from the ELAB.

Loosen the 7-pin plug-in connection (not shown in illustration).

Remove the fuel-injection tubing (6).
(Prevent the delivery-valve holder from coming loose by counterholding.)



Remove fastening screws (1) of rear support bracket of fuel-injection pump (picture a/b).
Loosen fastening screws (2) at distributor head (picture b).



By screwing the press-off screw into the holding and press-off device KDEP 1156 (arrow), loosen the injection-pump gear from the cone of the drive shaft and remove the injection pump.

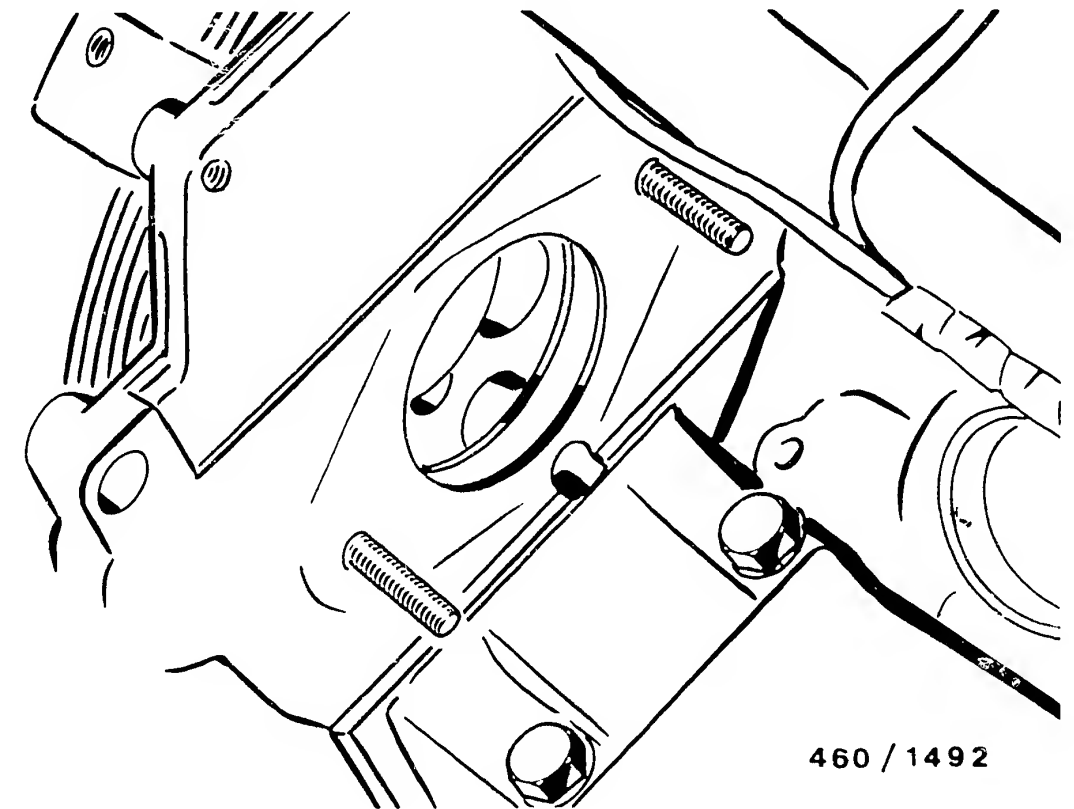
Note :

If necessary, briefly hit the press-off device if the gear is seated firmly under tension.

Do not remove the holding and press-off device.

Unscrew the shear-off screw.

Return to trouble-shooting chart.



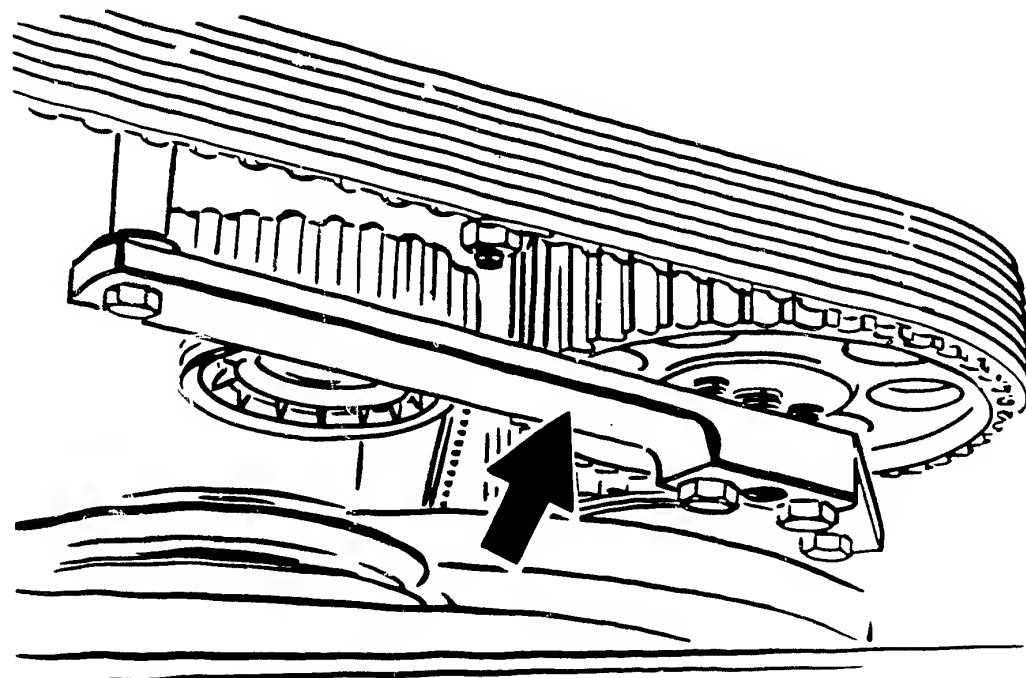
INSTALLING THE INJECTION PUMP

Screw two hexagonal nuts on to the drive shaft of the injection pump and counterlock. Turn the drive shaft until the spring groove points to outlet "A" of the hydraulic head. Unscrew the hexagonal nuts and insert the Woodruff key into the spring groove.

Guide the injection pump into the driving gear and slightly tighten the fastening nuts on the pump flange.

Note:

When inserting the injection pump, make sure that the Woodruff key is seated properly.

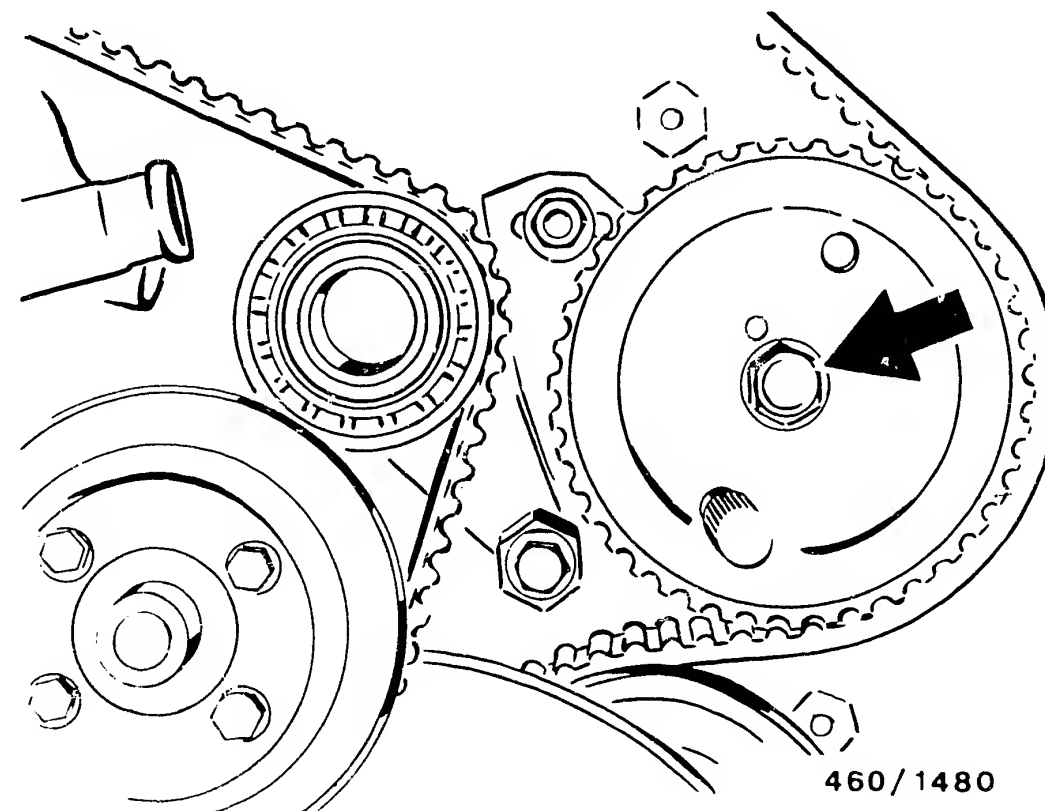


438 / 1500

Remove the holding and press-off device
KDEP 1156 (arrow).

N o t e :

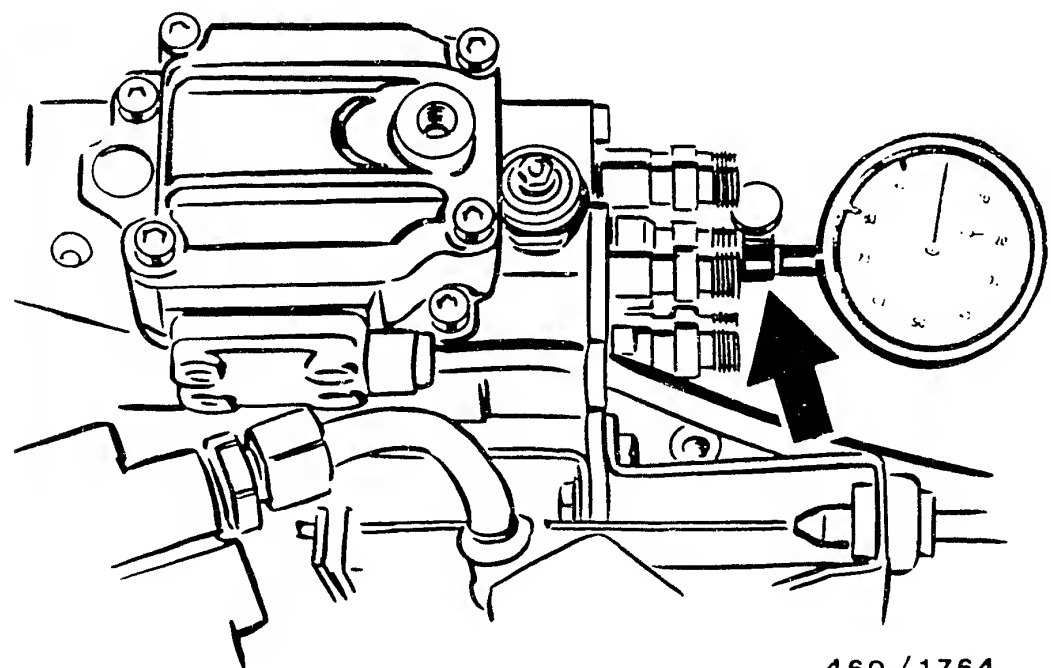
When removing the device, the injection-pump driving gear must not slip off the cone of the drive shaft, since this would otherwise mean that the engine timing must be re-adjusted.



460 / 1480

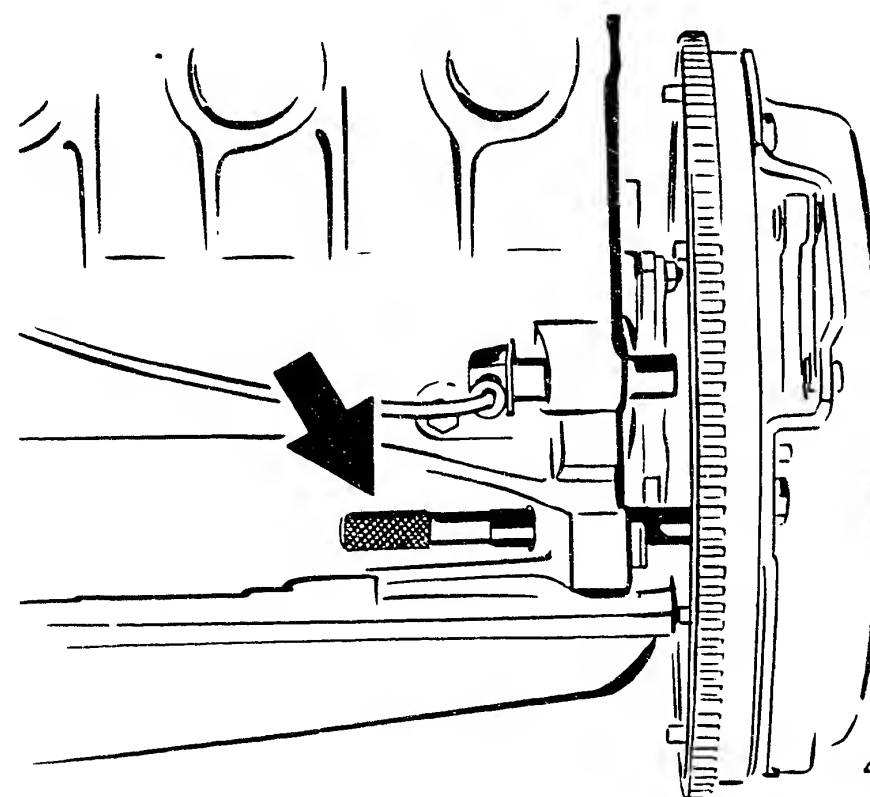
Screw on the fastening nut of the injection-
pump gear (arrow).

Lock the injection-pump gear using setting mandrel
KDEP 1138 and remove it again after tightening the
nut to 45 Nm.



460 / 1764

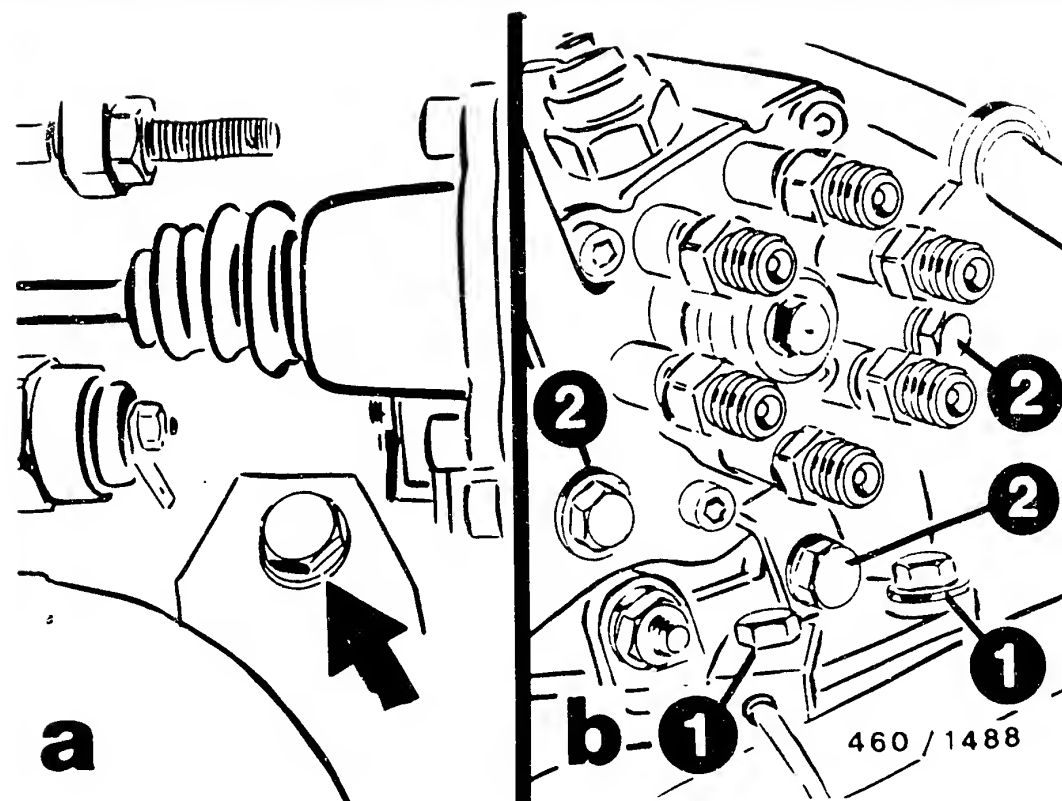
Remove the setting devices KDEP 1136/1139.
 Unscrew the bleeder screw from the central screw plug (triangle-head bolt) of the hydraulic head.
 Screw the measuring tool KDEP 1085 (arrow) into the tapped hole of the bleeder screw.
 Mount the mini dial indicator with measuring insert into the measuring tool KDEP 1085.



460 / 0474

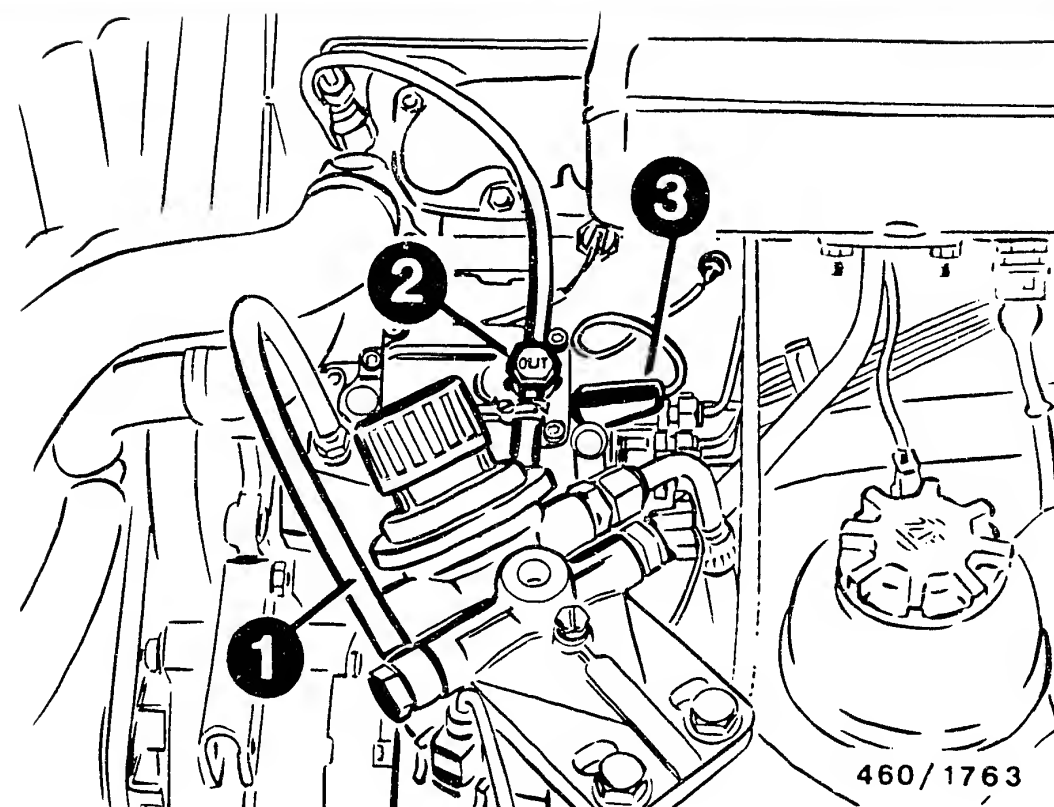
Pre-tension the dial indicator approx. 2.5 mm.
 Turn the crankshaft slowly opposed to the direction of rotation of the engine until the pointer of the dial indicator no longer moves.
 Set the dial indicator to "0".
 Turn the crankshaft in the direction of rotation of the engine until cyl. 1 is at TDC.
 Lock the flywheel using setting mandrel KDEP 1139 (arrow).
 Settings: see brief instructions.

For adjusting the setting, the pump must be swivelled until the setting is obtained.



Tighten the nuts on the injection-pump flange.
Tighten the fastening screws of the bracket (1)
and of the hydraulic head (2) to 25 Nm.

Remove the setting mandrel KDEP 1139.
Turn the crankshaft through two rotations
and check the setting.
Remove the measuring tool KDEP 1085 with dial
indicator.
Assemble the bleeder screw with a new seal ring.

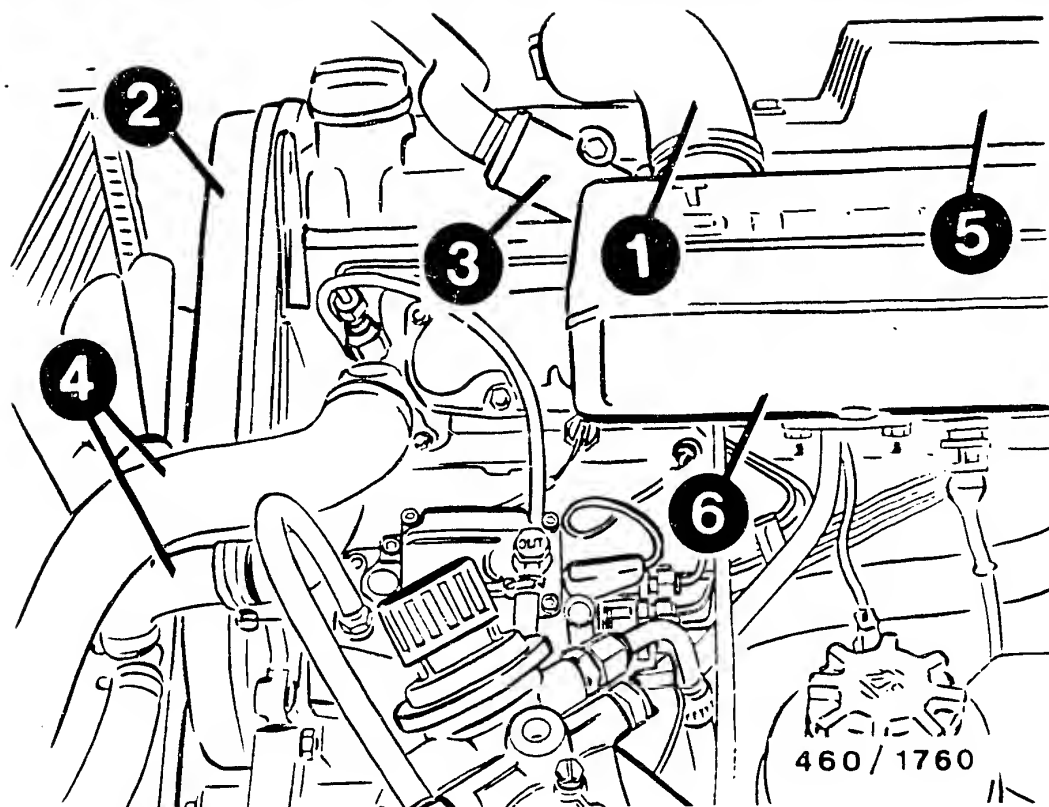


1 = Fuel inlet line
2 = Fuel return line
3 = ELAB

Assemble the fuel-injection tubing (prevent
the delivery-valve holder from turning by
counterholding).

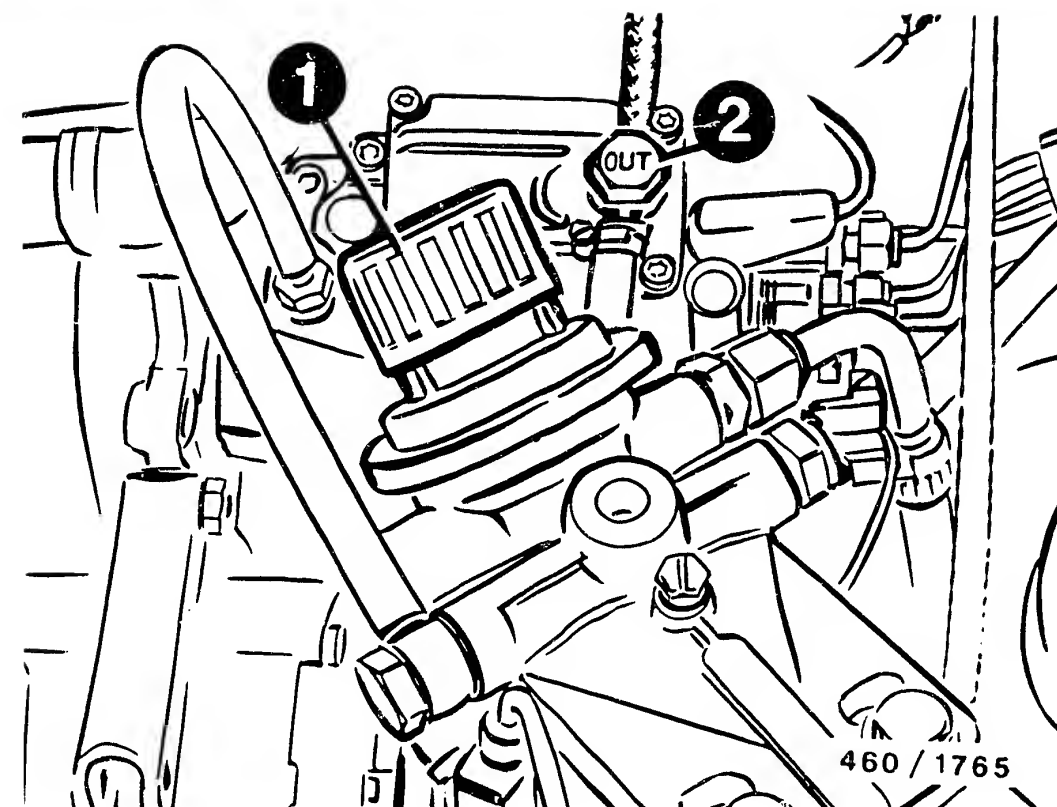
Assemble the fuel inlet line and return
line (the inlet-union screw of the fuel
return line must be marked "OUT").

Mount the electrical connection line to the
ELAB and make a 7-pin plug-in connection.



- 1 = Intake bridge
- 2 = Toothed-belt cover
- 3 = Crankcase ventilation
- 4 = Coolant hoses
- 5 = Cylinder-head cover
- 6 = Air collector

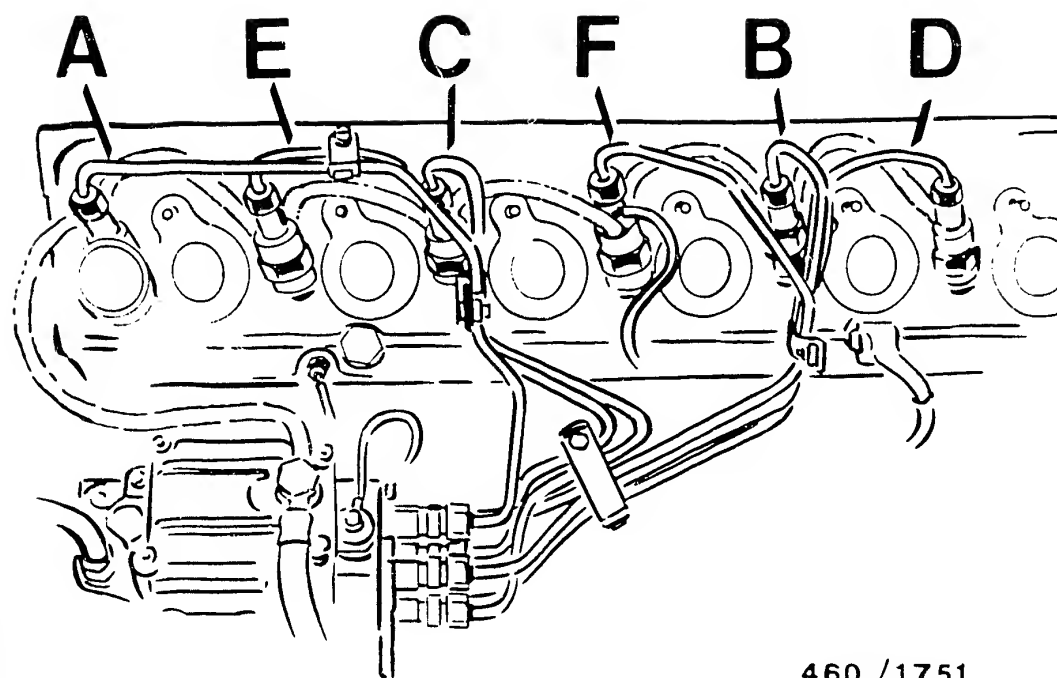
Mount the air connector with new gaskets.
 Mount the cylinder-head cover, crankcase ventilation, and vacuum connection.
 Mount the intake bridge.
 Mount the toothed-belt cover.
 Connect the coolant hoses.
 Connect the negative cable to the battery.



- 1 = Hand primer
- 2 = Inlet-union screw

Bleeding the fuel system

Loosen the inlet-union screw of the fuel return line.
 Using the hand primer, pump for so long until fuel escapes from the side of the inlet-union screw (catch the fuel overflowing).



460 /1751

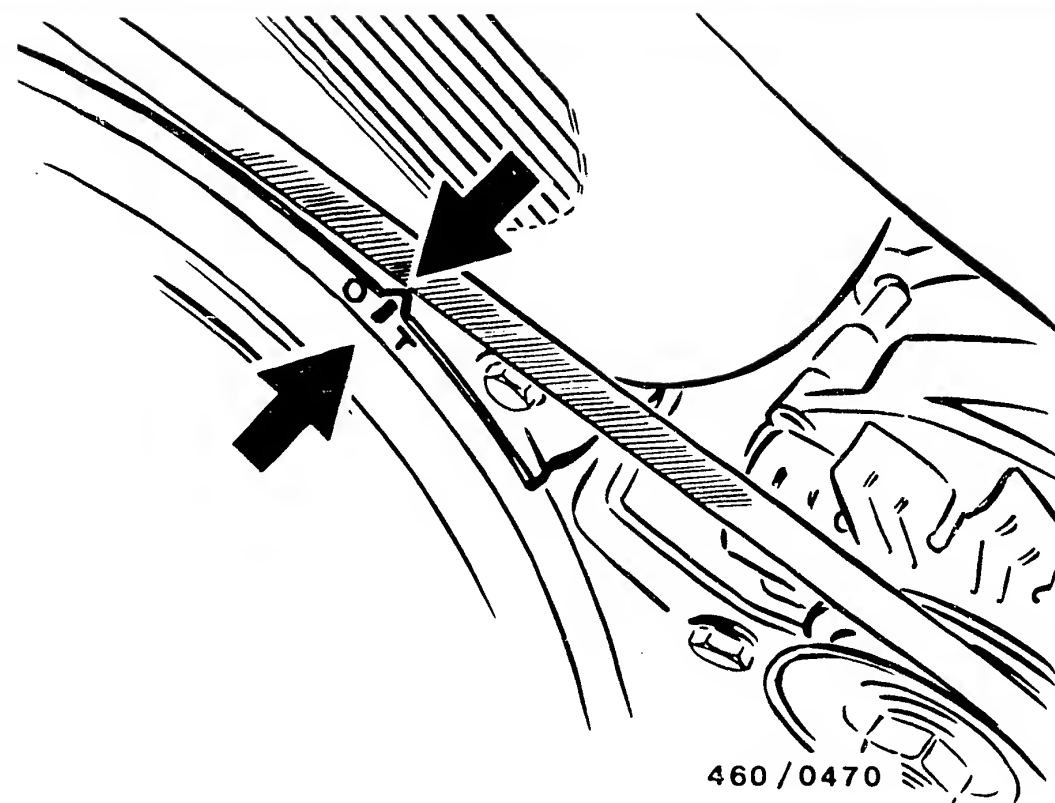
Loosen the union nuts of the fuel-injection tubing at the nozzle-holder assemblies (illustration, arrows).

Actuate the starting motor of the engine without pre-heating until fuel escapes from the union nuts of the nozzle-holder assemblies (catch fuel).

Tighten the union nuts.

Actuate the starting motor until the engine starts.

Return to trouble-shooting chart.



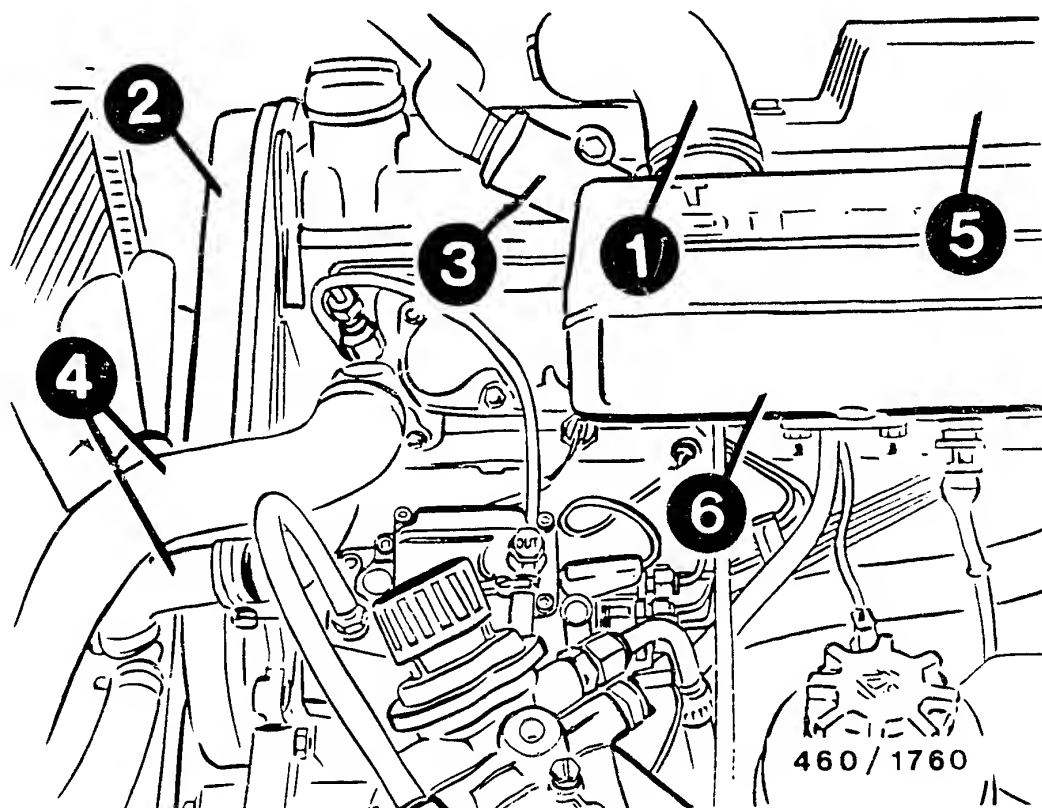
460 /0470

TESTING AND ADJUSTING THE ENGINE TIMING

Testing the engine timing.
Disconnect the negative cable from the battery.

Turn the crankshaft until the TDC marking (cyl. 1) on the pulley aligns with the reference mark (arrow).

The piston of cylinder 1 is at TDC (valves of cylinder 6 are overlapping).



- 1 = Inlet bridge
- 2 = Toothed-belt cover
- 3 = Crankcase ventilation
- 4 = Coolant hoses
- 5 = Cylinder-head cover
- 6 = Air collector

Remove the crankcase ventilation.

Remove the inlet bridge and vacuum connection (not shown in illustration).

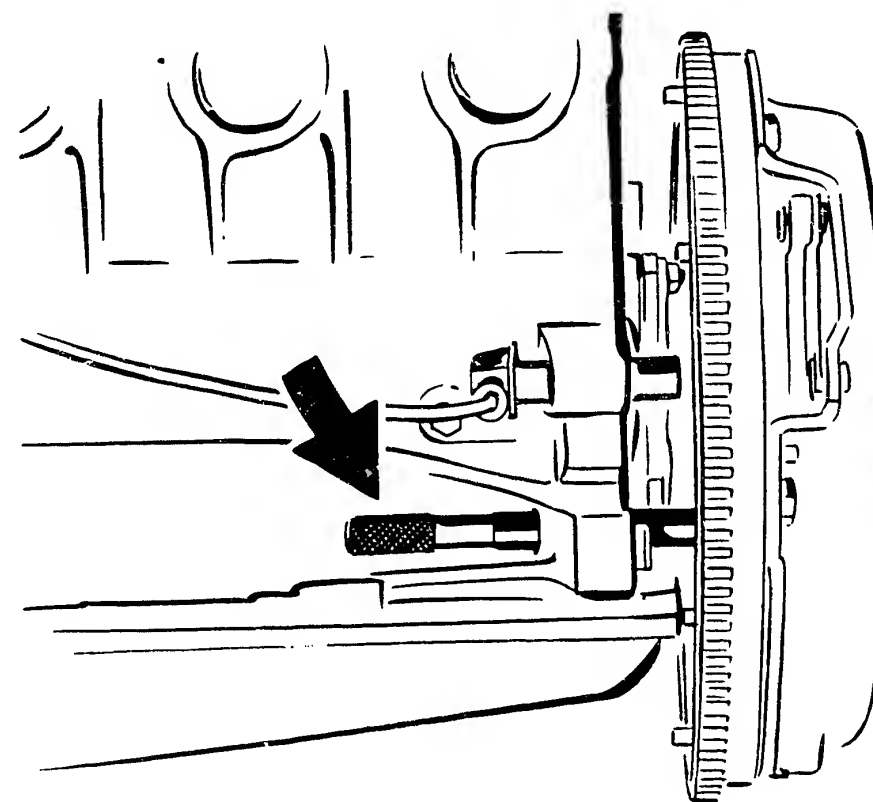
Remove the cylinder-head cover.

Remove the clamp.

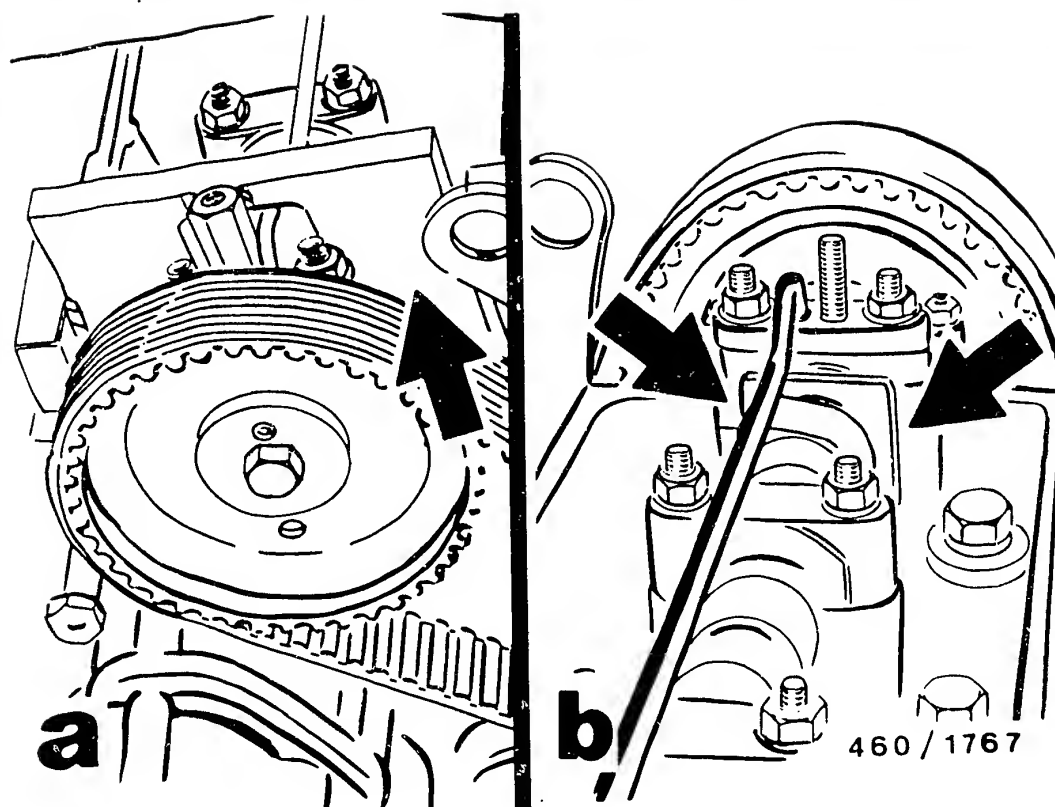
Unclip the coolant hose with commercially available crimp-on clip just behind the coolant pump (catch the coolant).

Remove the V-belt.

Remove the toothed-belt cover.



Lock the flywheel with setting mandrel KDEP 1139 (arrow).

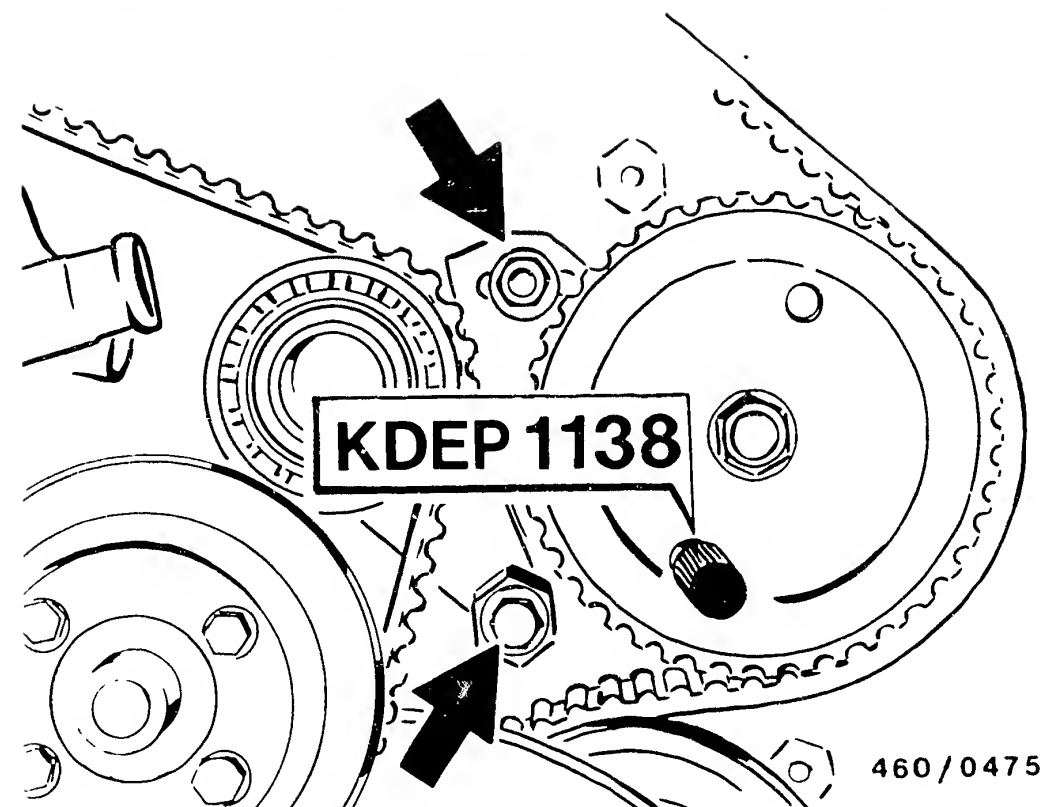


Lock the camshaft using stop device KDEP 1136 (illustration a, arrow). The valves of cylinder 1 overlap at this point.

If the stop device cannot be positioned, the engine timing must be adjusted (illustration b).

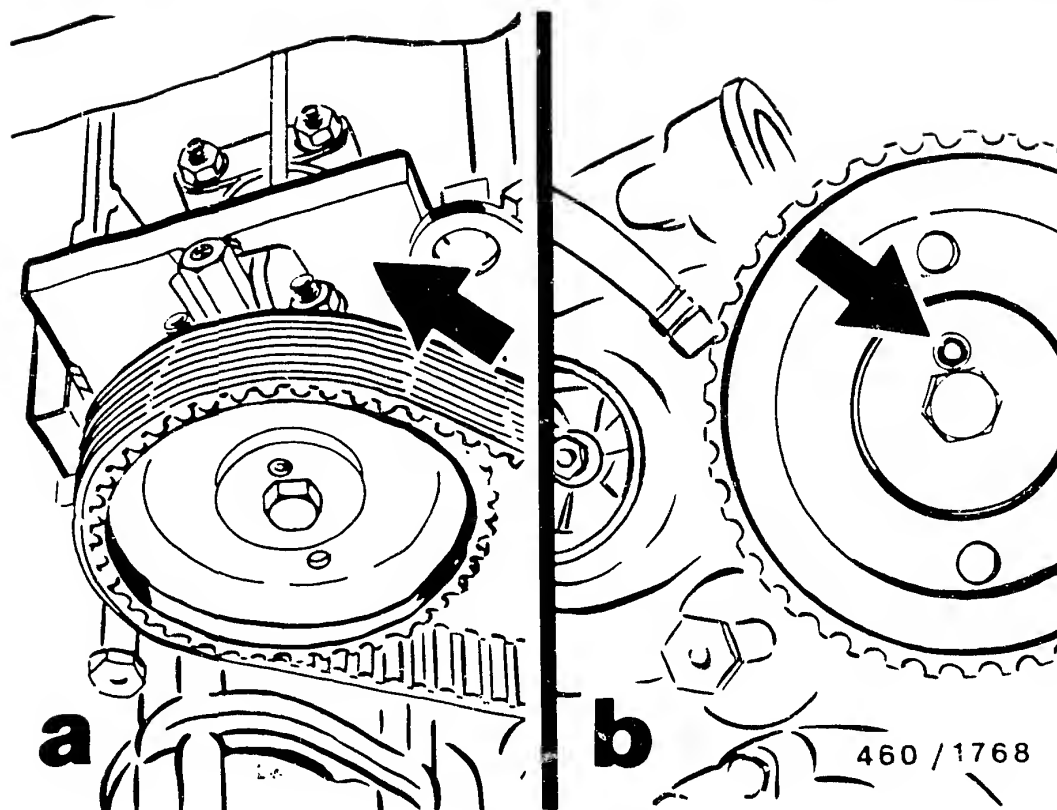
Note:

The stop device fits only the two worked surfaces of the square (arrows).



Adjusting the engine timing

Loosen the fastening nut/screw of the tensioning-wheel console (arrows). Release the tension on the toothed belt and remove the belt.



Turn the camshaft until the stop device can be positioned over the worked surfaces of the square (illustration a).

Note:

Do not remove the setting mandrel KDEP 1139.

Loosen the fastening screw of the camshaft gear.

Position the camshaft gear towards the pin in the direction of rotation until it makes contact (arrow).

Tighten the fastening screw of the camshaft gear by hand (illustration b).

Put on the toothed belt.

Note :

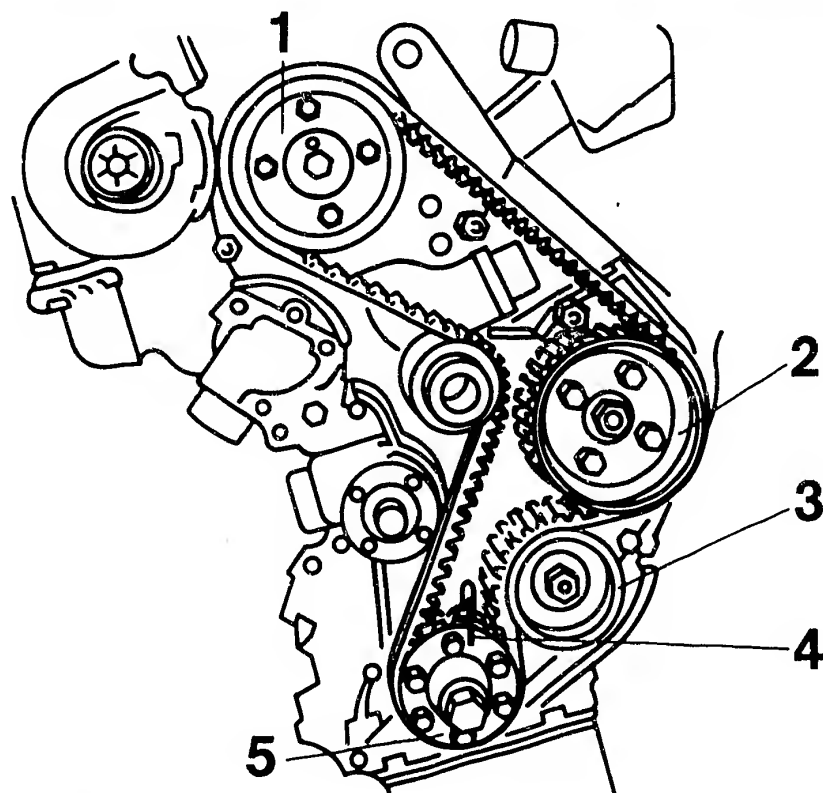
If renewed use is made of a used toothed belt, this is only to be fitted in the same direction of running as before.

Porous or worn toothed belts are to be renewed.

If the toothed belt is not renewed, then continue on Coordinate K 21.

Continuation not necessary here.

Never crank crankshaft or camshaft without fitted toothed belt, so as to stop the valves catching on the pistons.



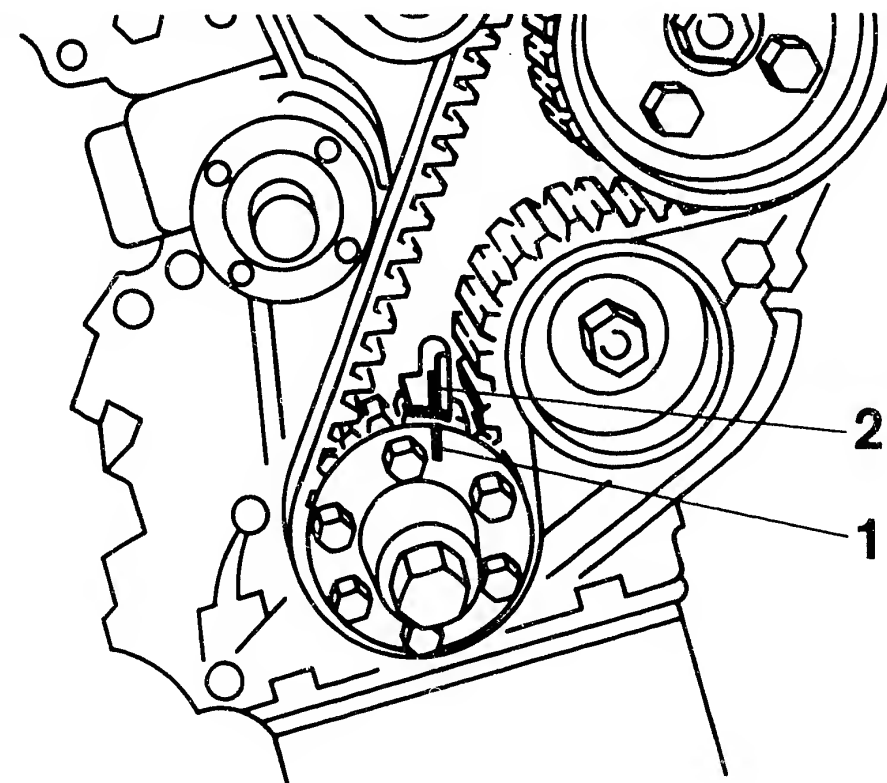
460/0489

- 1 = Camshaft gear
- 2 = Injection-pump gear
- 3 = Toothed-belt pulley on intermediate shaft
- 4 = Mark on vibration damper
- 5 = Vibration-damper hub

Replacing the toothed belt

Remove the V-belt pulley (vibration damper) from the vibration-damper hub of the crankshaft.

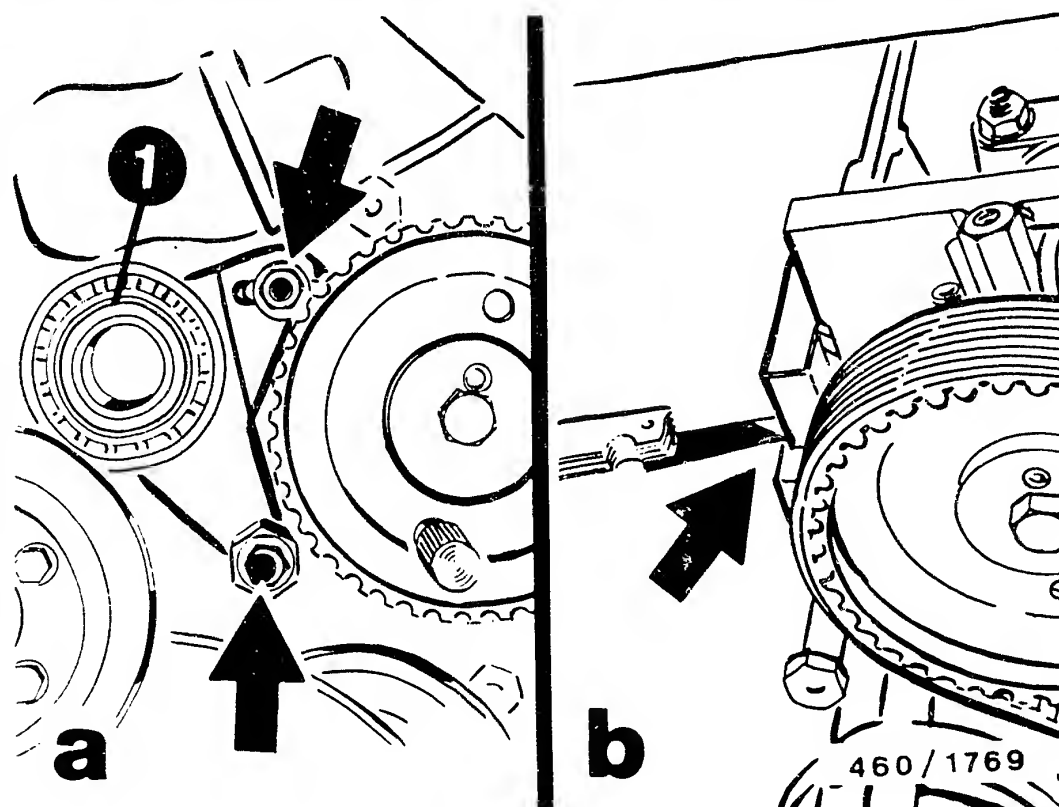
Remove the toothed belt.



460/0490

- 1 = Marking on vibration damper
- 2 = Reference mark, toothed-belt cover

Before fitting the toothed belt, check whether the mark on the vibration-damper hub of the crankshaft aligns with the reference mark on the rear toothed-belt cover.



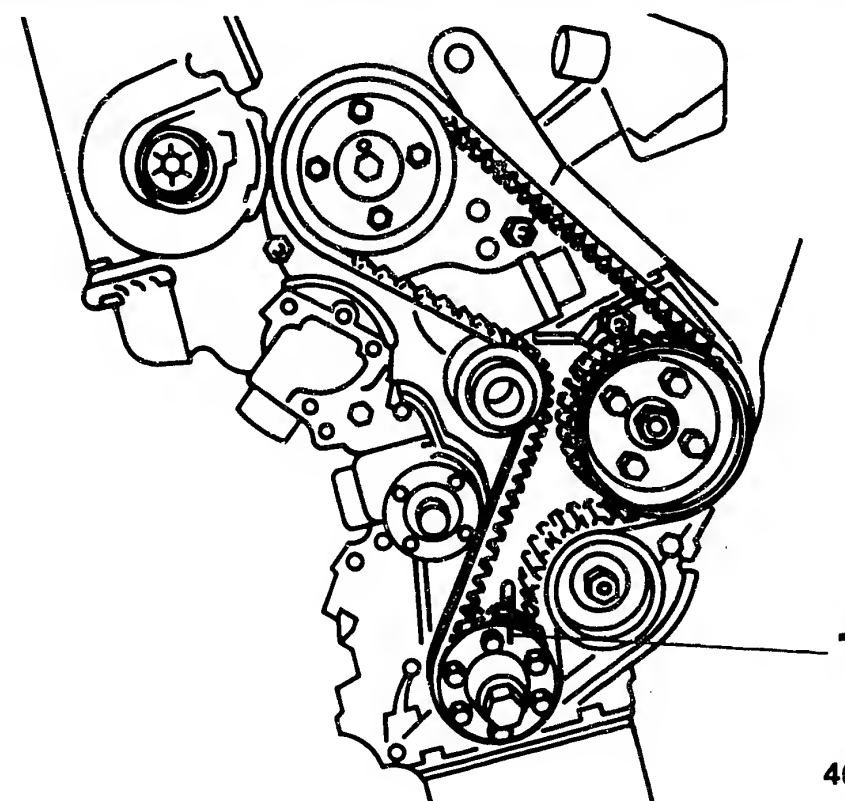
1 = Tensioning roller

Tighten the fastening nut/screw of the clamping-nut console by hand. (Illustration a, arrows).

Fit the toothed belt, starting from the crankshaft gear, into the toothing of the injection-pump gear and continue under tension over the camshaft gear.

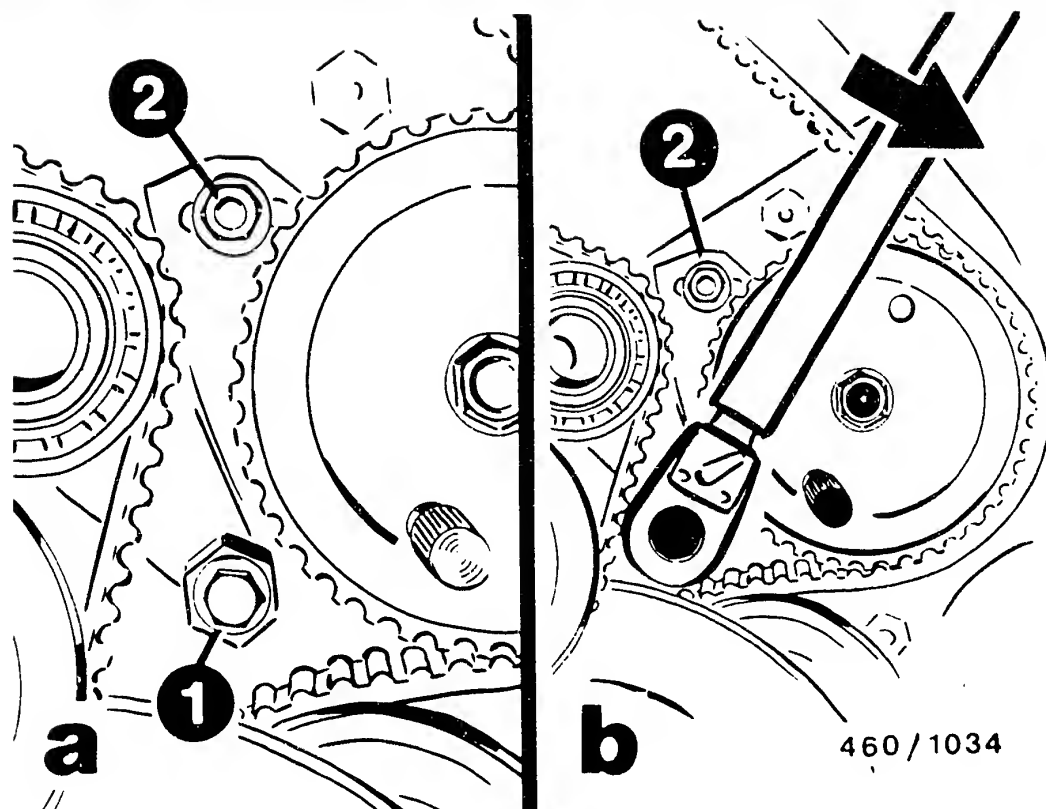
Note:

With a new toothed belt, a 2.5 mm thick feeler gauge must be positioned between the sealing surface (cylinder-head cover) and the stop device KDEP 1136 on the outlet side (illustration b, arrow).



460/1030

Mount the V-belt pulley on to the vibration-damper hub (1) of the crankshaft and tighten to 22 - 24 Nm.



1 = Clamping point
2 = Upper fastening nut

A t t e n t i o n !

The toothed belt must not be able to slip over the teeth.

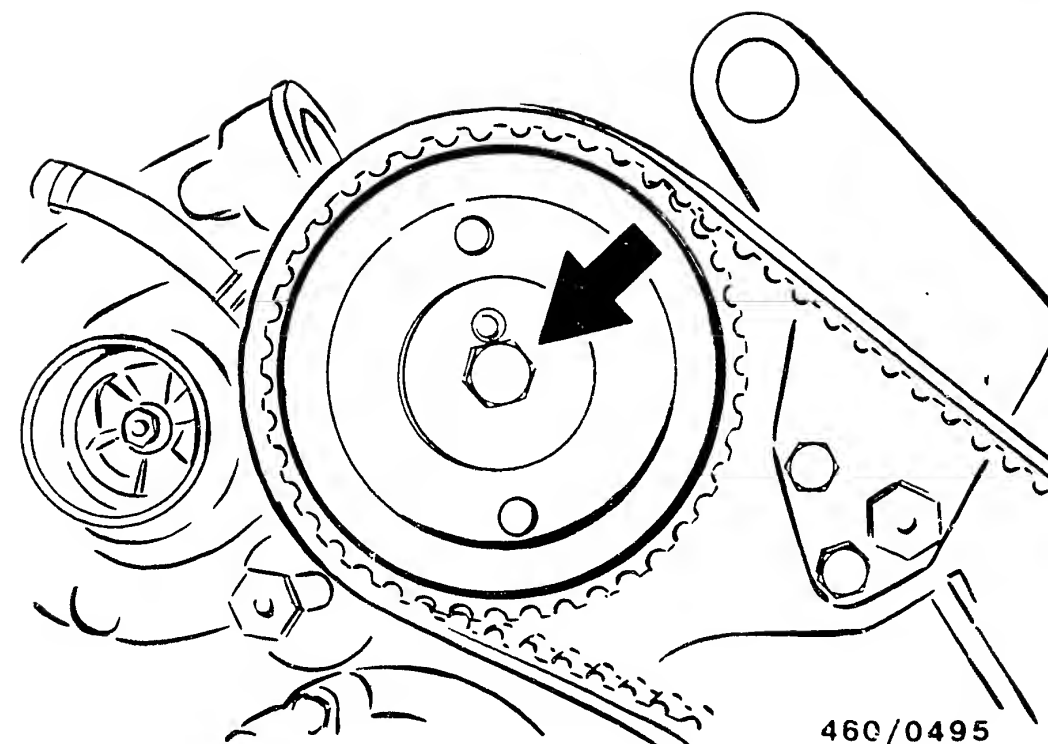
Pivot the tensioning roller towards the toothed-belt back (arrow) with 45 - 50 Nm at the clamping point and tension the toothed belt.

Tighten the upper fastening nut (2) to 20 - 24 Nm.

Note:

Use only a torque wrench with pointer (adjustable wrenches are not suitable).

Remove the torque wrench and tighten the lower fastening screw (1) to 20 - 24 Nm.

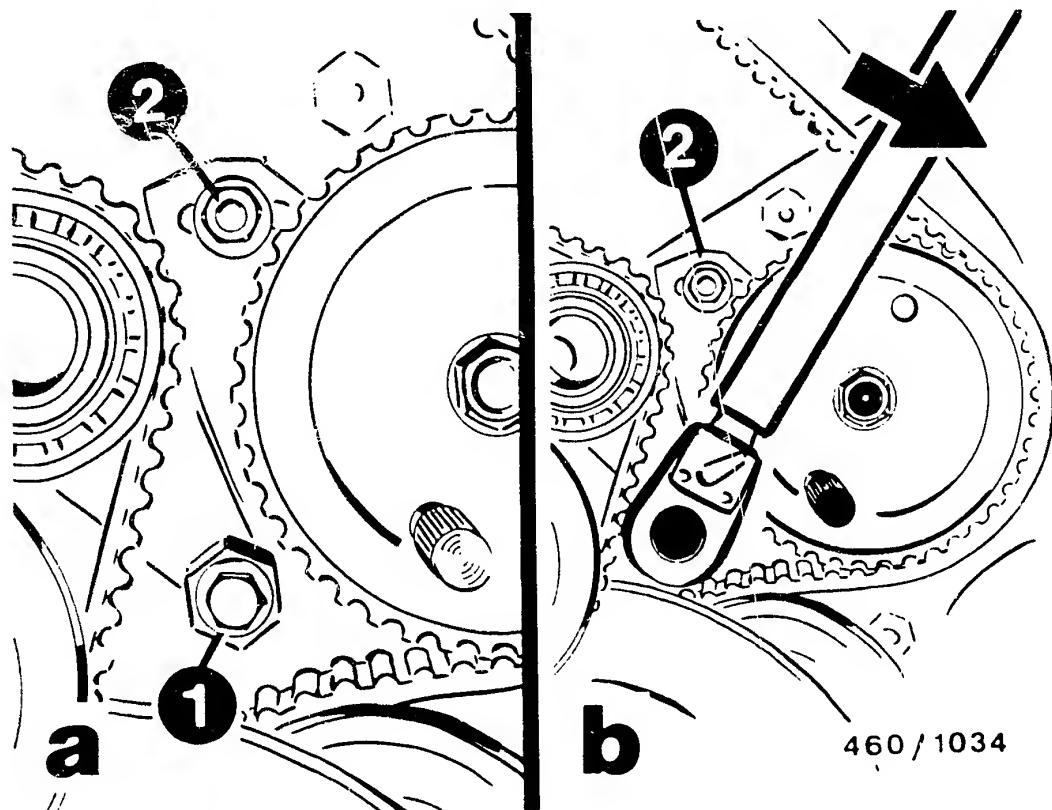


Tighten the camshaft gear to the specified torque of 65 - 70 Nm (arrow).

Remove the locking device KDEP 1136 from the camshaft and setting mandrel KDEP 1139 from the flywheel.

Position the V-belt of the alternator and tension.

Toothed-belt-change section complete, continue on Coordinate J26.



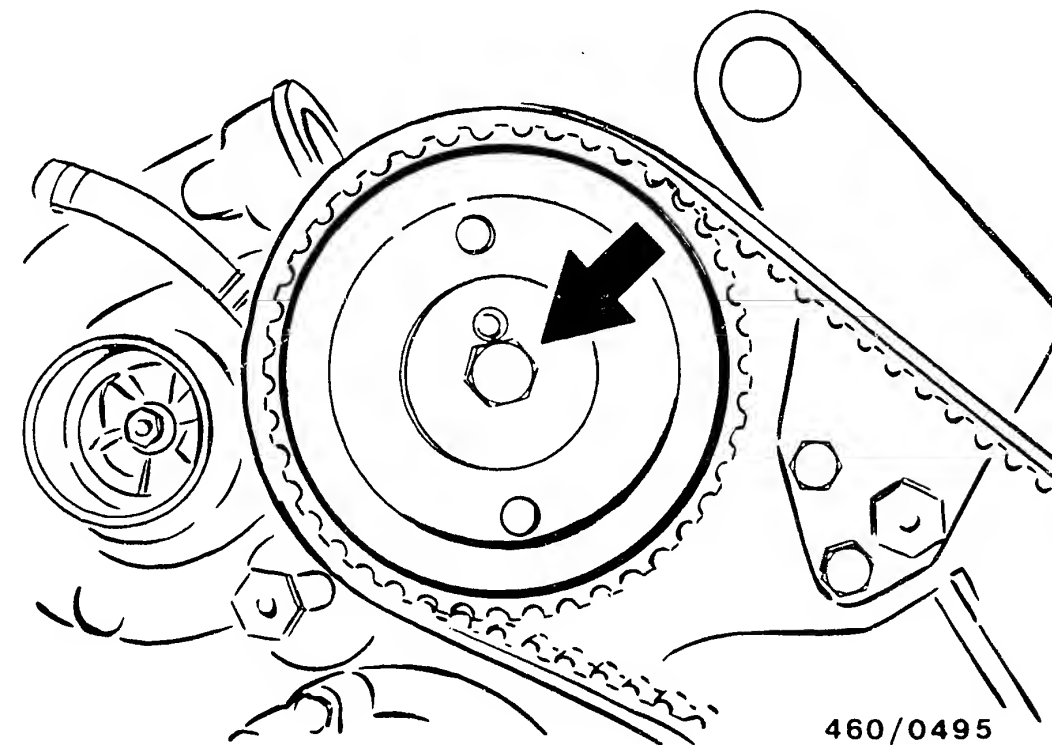
1 = Clamping point
2 = Upper fastening nut

Pivot the tensioning roller towards the toothed-belt back (illustration b, arrow) with 45 – 55 Nm (with more than 15,000 km travelled, 30 – 35 Nm) at the clamping point.

Tighten the upper fastening nut (2) to 20 – 24 Nm.

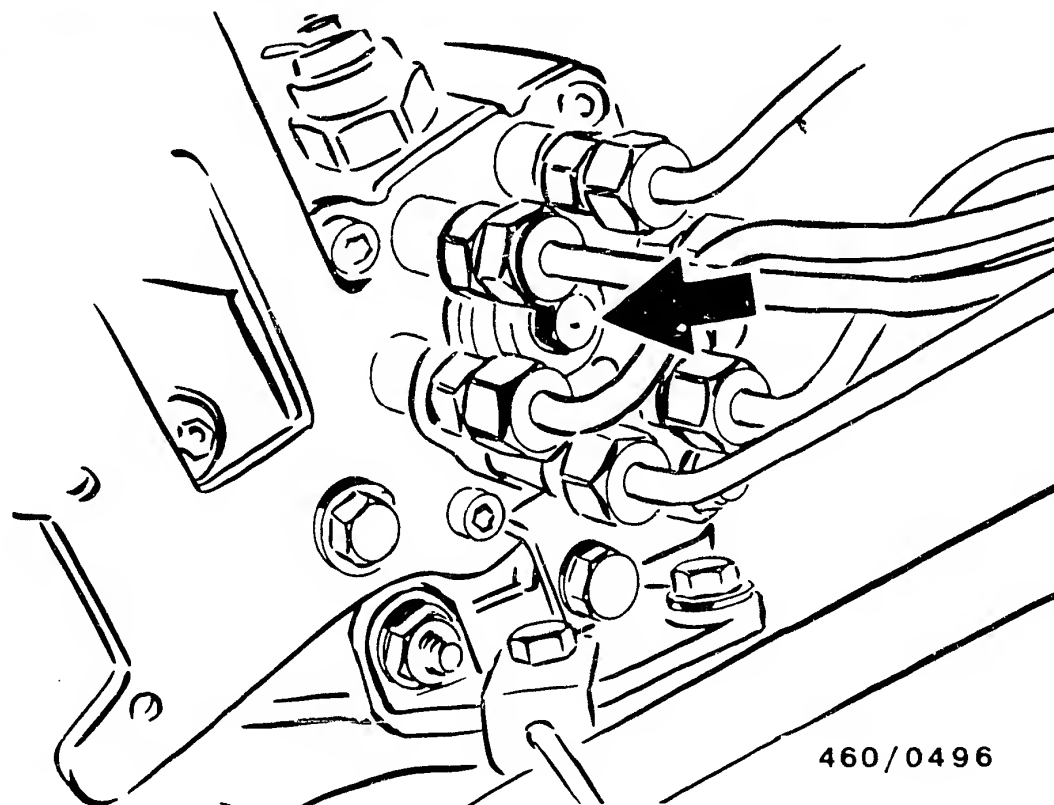
Use only a torque wrench with pointer (adjustable wrenches are not suitable).

Remove the torque wrench and tighten the lower fastening screw (1) to 20 – 24 Nm.



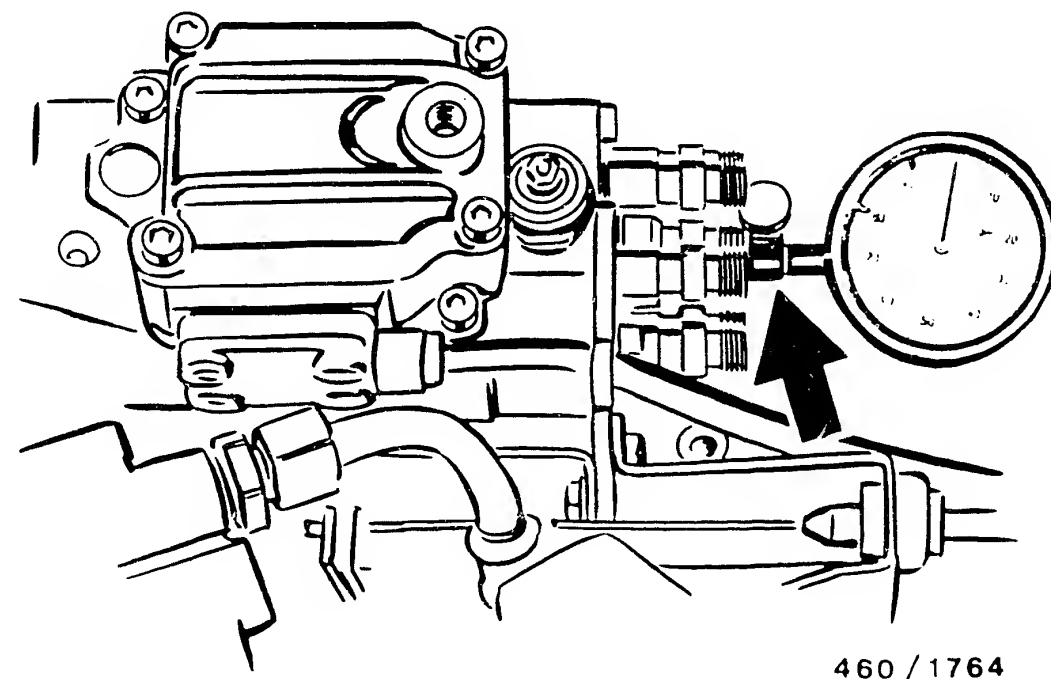
Tighten the camshaft gear to the specified torque of 65 – 70 Nm (arrow).

Remove the locking device KDEP 1136 from the camshaft and the setting mandrel KDEP 1139 from the flywheel.

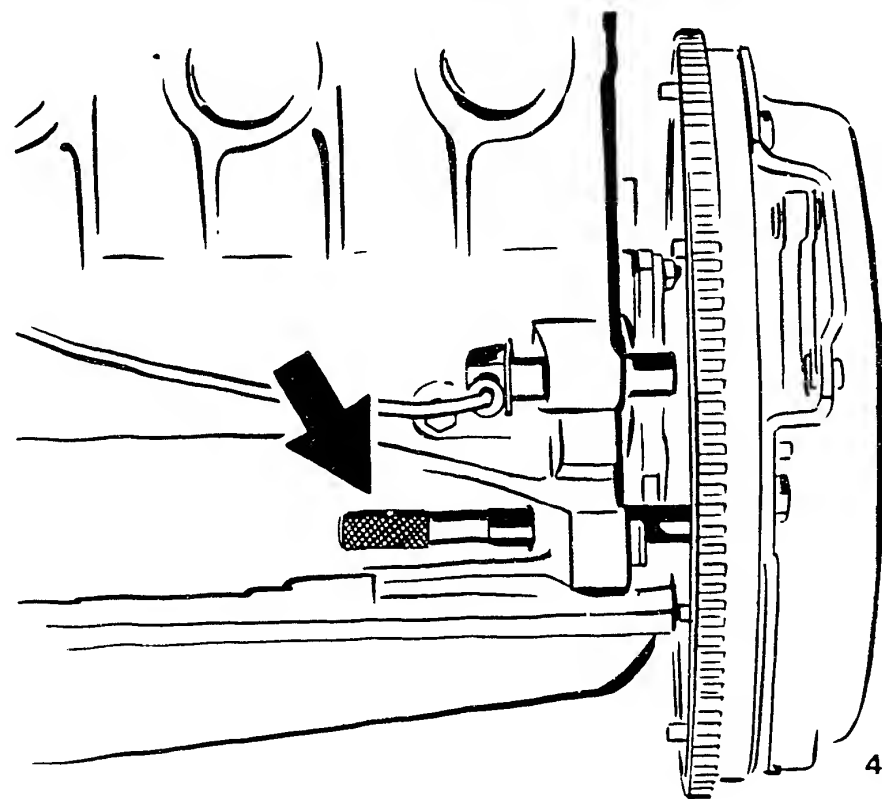


Remove the fuel-injection tubing from the injection pump and from the nozzle-holder assemblies (prevent the delivery-valve holder from coming loose by counterholding).

Screw the bleeder screw out of the central screw plug (triangle-head bolt) of the hydraulic head (arrow).



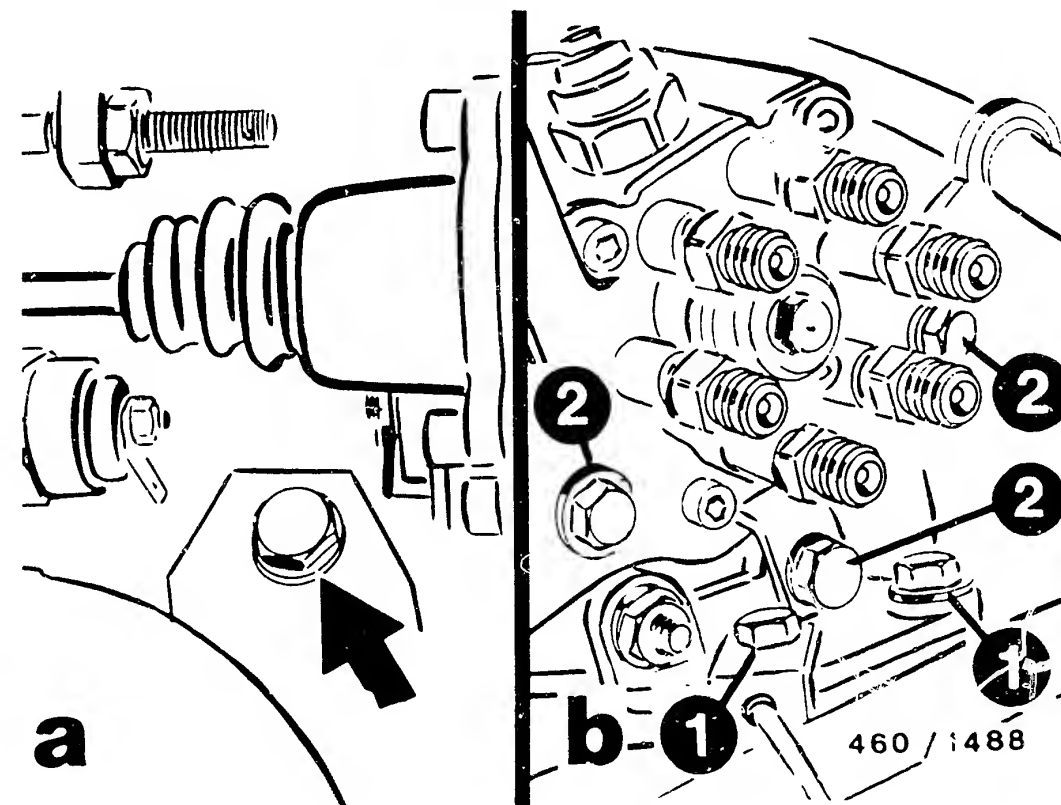
Screw the measuring tool KDEP 1085 (arrow) into the tapped hole of the bleeder screw. Mount the mini dial indicator with measuring insert into the measuring tool KDEP 1085.



460 / 0474

Pre-tension the dial indicator approx. 2.5 mm.
Slowly turn the crankshaft opposed to the direction of engine rotation until the pointer of the dial indicator no longer moves.
Set the dial indicator to "0".
Turn the crankshaft in the direction of engine rotation until cyl. 1 is at TDC.
Lock the flywheel using setting mandrel KDEP 1139 (arrow).
Settings: see brief instructions.

For adjusting the setting, swivel the pump until the setting is obtained.



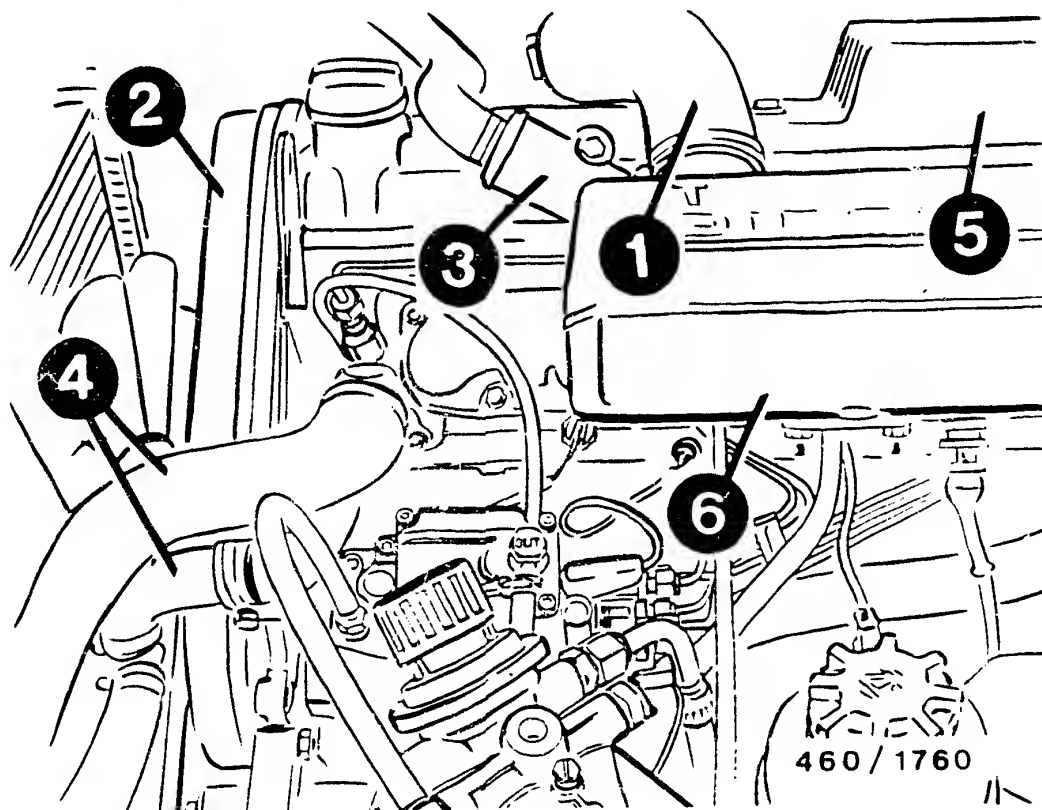
Tighten the nuts on the injection-pump flange.

Tighten the fastening screws of the bracket (1) and of the hydraulic head (2) to 25 Nm.

Remove the setting mandrel KDEP 1139.
Turn the crankshaft through two rotations and check the setting.

Remove the measuring tool KDEP 1085 with dial indicator.

Mount the bleeder screw with a new seal ring.



- 1 = Intake bridge
- 2 = Toothed-belt cover
- 3 = Crankcase ventilation
- 4 = Coolant hoses
- 5 = Cylinder-head cover
- 6 = Air collector

Mount the air collector with new gaskets.

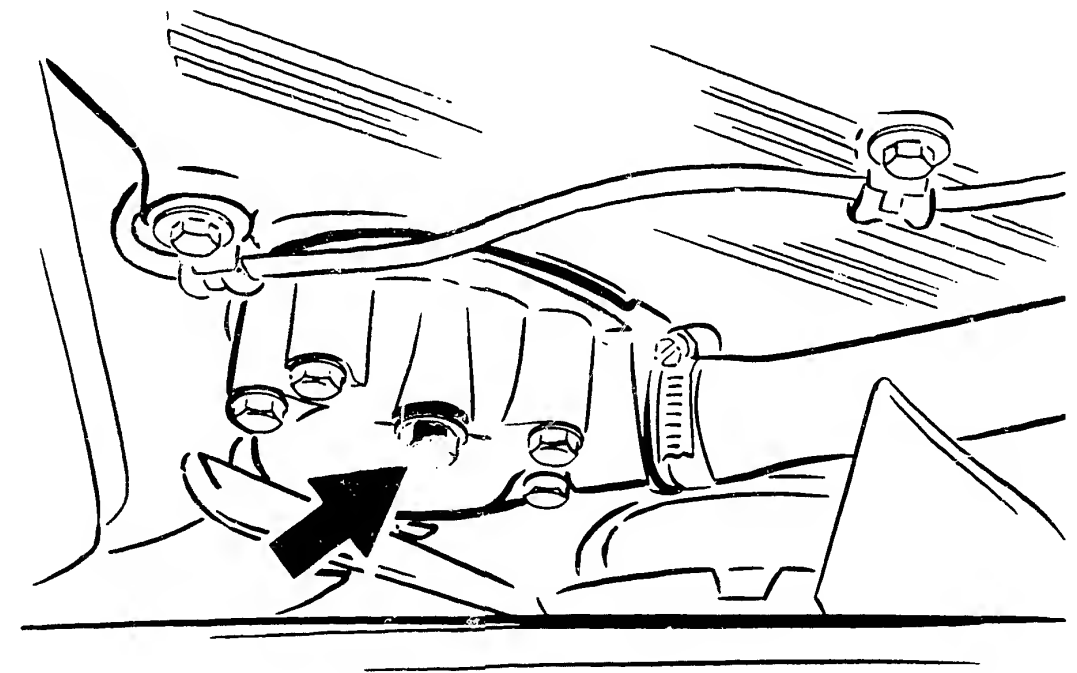
Mount the cylinder-head cover, crankcase ventilation, and vacuum connection.

Mount the intake bridge.

Mount the toothed-belt cover.

Connect the coolant hoses.

Connect the negative cable to the battery.



460 / 0503

Bleeding the cooling system

Top up the coolant up to the marking on the expansion tank.

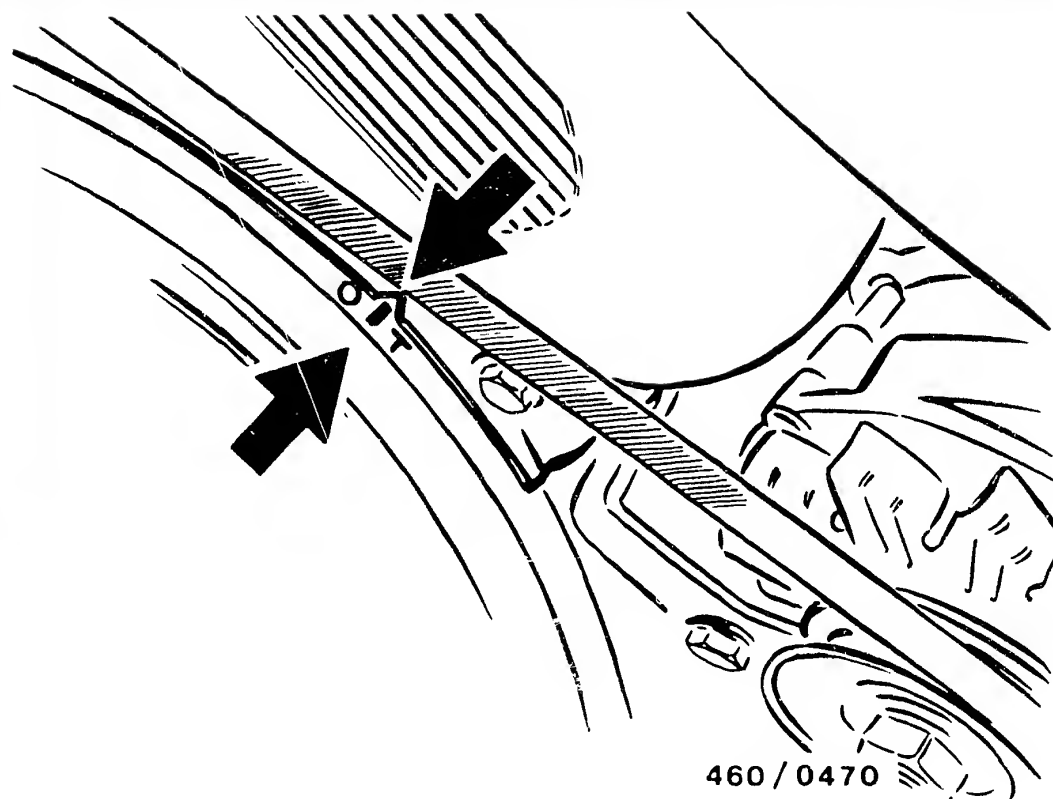
Open the heating valve fully.

Leave the engine running until it reaches normal operating temperature.

Loosen the bleeder screw (arrow) at the water pump until coolant escapes.

Tighten the bleeder screw.

Return to trouble-shooting chart.

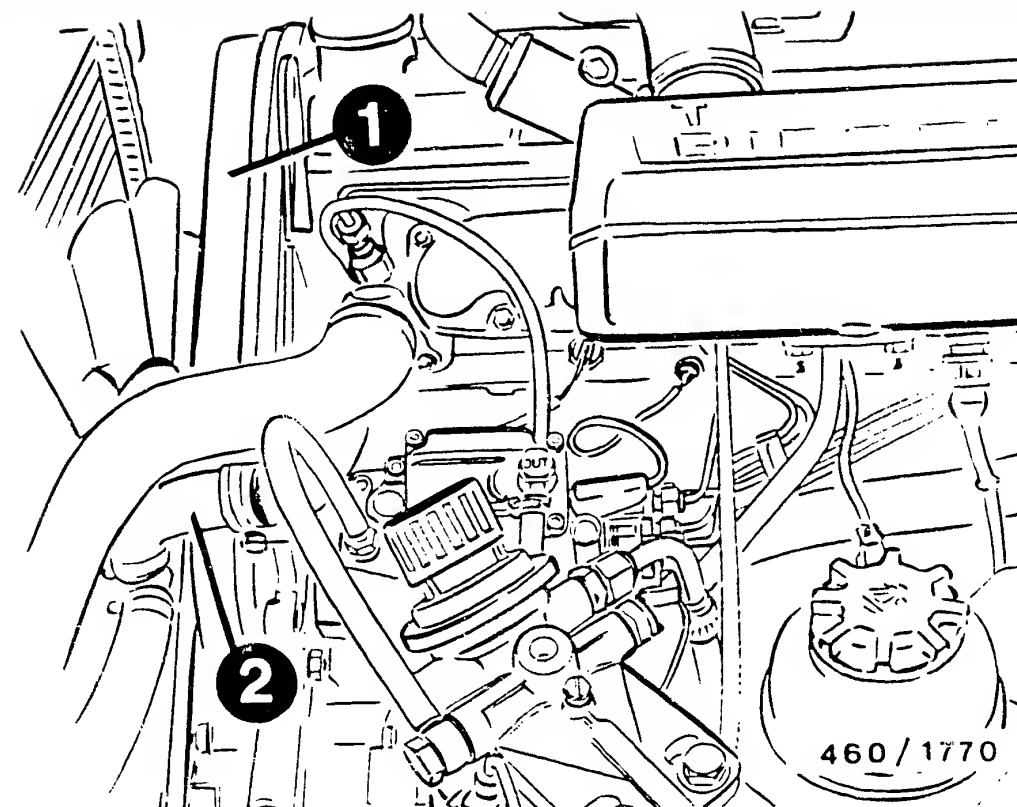


COORDINATION, INJECTION PUMP - ENGINE (INJECTION TIMING)

Disconnect the negative cable from the battery.

Turn the crankshaft until the TDC marking (cyl.1) on the pulley aligns with the reference mark (arrow).

The piston of cylinder 1 is at TDC (valves of cylinder 6 are overlapping).



1 = Toothed-belt cover

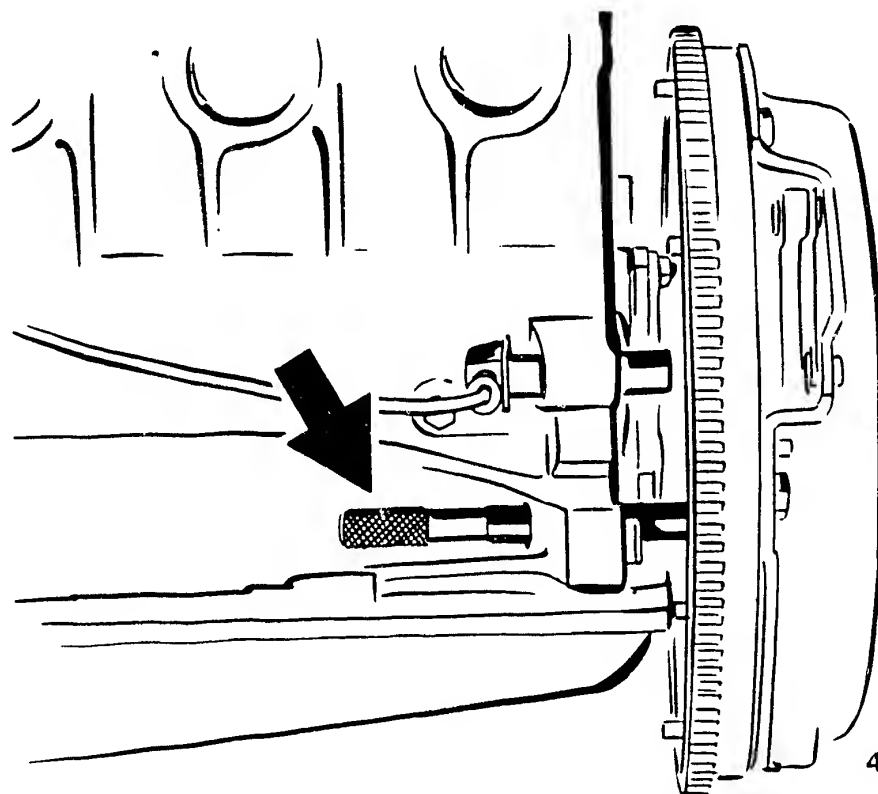
2 = Coolant hose

Clip the coolant hose just behind the water pump with a commercially available crimp-on clip.

Loosen the hose connector and pull off the coolant hose.

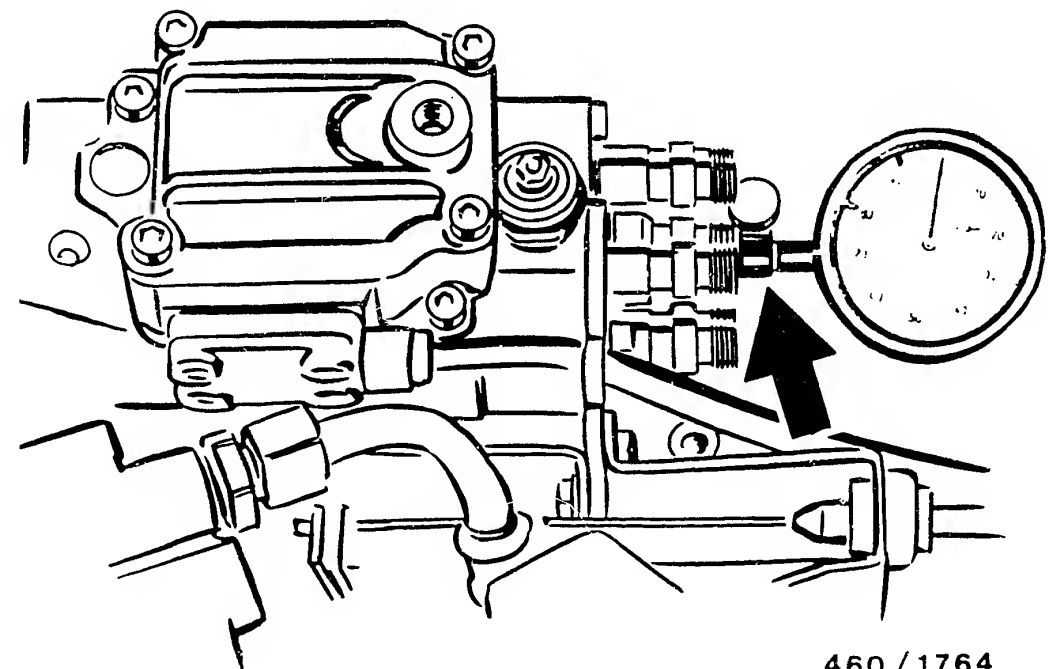
Catch the coolant.

Remove the toothed-belt cover.



460 / 0474

Lock the flywheel with setting mandrel KDEP 1139 (arrow).



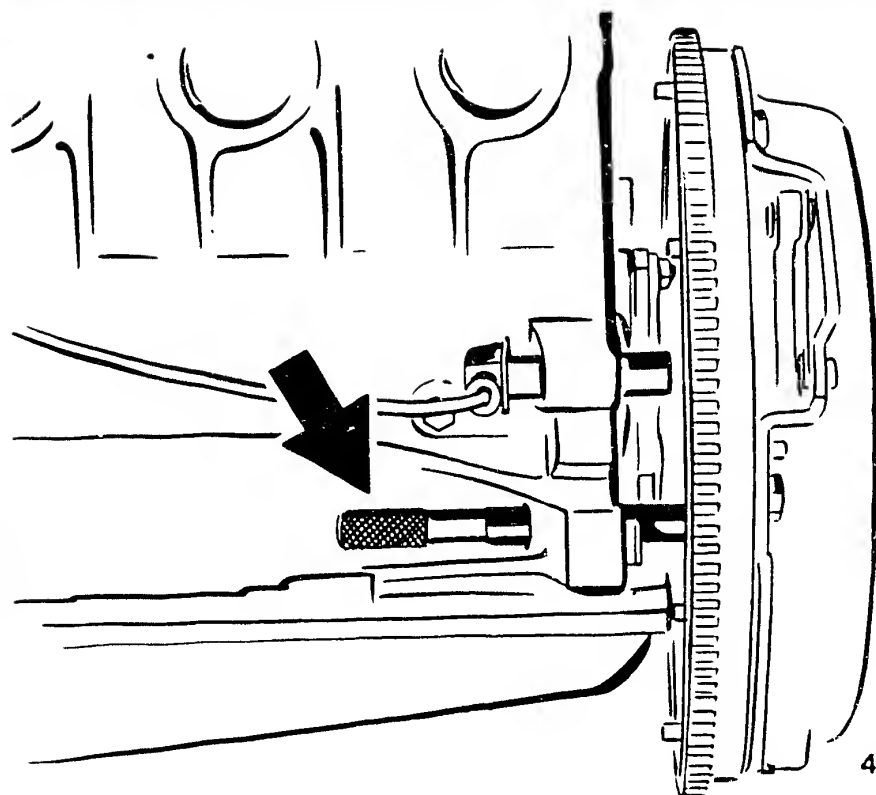
460 / 1764

Remove the fuel-injection tubing from the pump and from the nozzle-holder assemblies (prevent the delivery-valve holder from coming loose by counterholding).

Unscrew the bleeder screw from the central screw plug (triangle-head bolt) of the hydraulic head.

Screw the measuring tool KDEP 1085 (arrow) into the tapped hole of the bleeder screw.

Mount the mini dial indicator with measuring insert into the measuring tool KDEP 1085.



460 / 0474

Pre-tension the dial indicator approx. 2.5 mm.

Slowly turn the crankshaft opposed to the direction of engine rotation until the pointer of the dial indicator no longer moves.

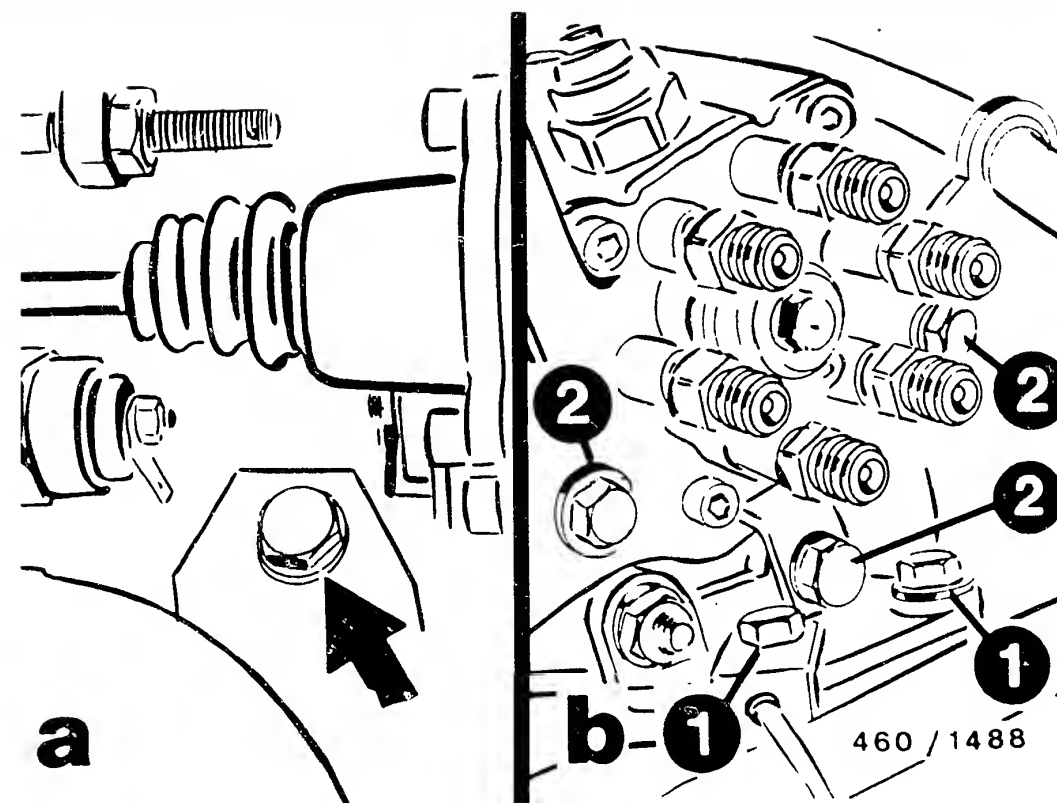
Set the dial indicator to "0".

Turn the crankshaft in the direction of engine rotation until cyl. 1 is at TDC.

Lock the flywheel using setting mandrel KDEP 1139 (arrow).

Settings: see brief instructions.

For adjusting the setting, pivot the pump until the setting is obtained.



460 / 1488

Tighten the nuts on the injection-pump flange.

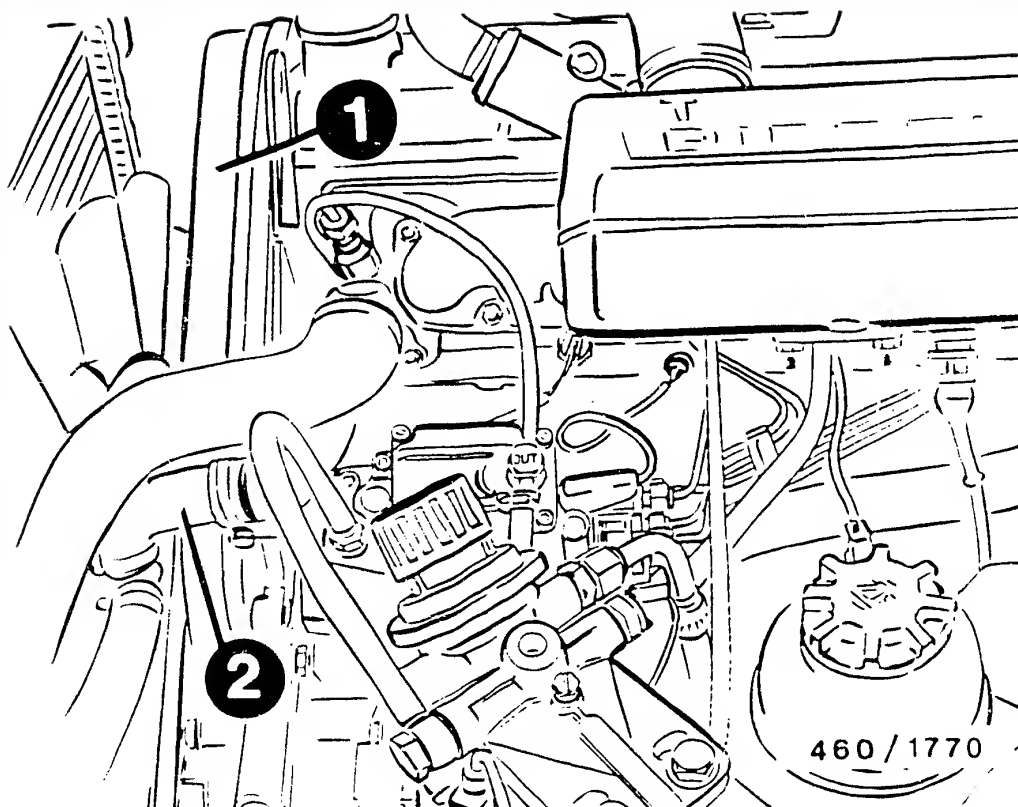
Tighten the fastening screws of the bracket (1) and of the hydraulic head (2) to 25 Nm.

Remove the setting mandrel KDEP 1139.

Turn the crankshaft through two rotations and check the setting.

Remove the measuring tool KDEP 1085 with dial indicator.

Mount the bleeder screw with a new seal ring.



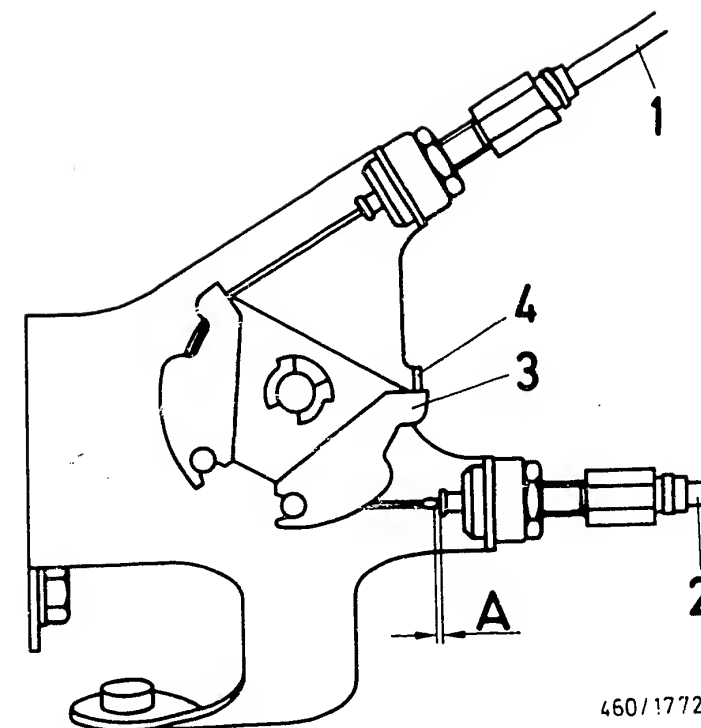
- 1 = Toothed-belt cover
- 2 = Coolant hose

Mount the toothed-belt cover.
Mount the coolant hose onto the water pump and remove the crimp-on clamp.
Connect the negative cable to the battery.
Bleed the fuel system.

Bleeding the cooling system

Top up the coolant up to the marking on the expansion tank.
Seal off the expansion tank.
Open the heating control fully.
Leave the engine running until it reaches normal operating temperature.
Loosen the bleeding screw (arrow) at the water pump until coolant escapes.
Tighten the bleeder screw.

Return to trouble-shooting chart.



- 1 = Bowden cable, accelerator pedal
- 2 = Bowden cable, automatic transmission
- 3 = Reverse-transfer lever
- 4 = Stop

SETTING THE AUTOMATIC TRANSMISSION CONTROL

Set the bowden cable of the accelerator pedal so that the reverse-transfer lever makes contact with the stop.

Set the bowden cable of the automatic transmission so that dimension A (0.25 - 0.50 mm) is obtained.

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